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## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

### SECTION K—PHYSIOLOGY AND EXPERI- MENTAL MEDICINE.

#### SYMPOSIUM ON YELLOW FEVER AND OTHER INSECT-BORNE DISEASES. II.

#### *Without Mosquitoes there can be no Yellow Fever: JAMES CARROLL.*

It seems incredible, but is, nevertheless true, that at the present time there are still in the United States many physicians who oppose the idea that the mosquito is the sole means by which yellow fever is carried from one person to another. They refuse to believe that the natural disease can not be contracted in any other way than through the bite of the mosquito. The fact, however, has been repeatedly demon- strated and the evidence in its support has now become overwhelming. The tremen- dous importance of this subject, in a city which, by reason of her location and com- mercial intercourse with Central and South America, may be regarded as the gateway through which a disastrous epidemic may at any time be introduced into the United States, is my apology for again taking up so trite a subject. It is the duty of those who are familiar with the facts to com- municate them to the members of the pro- fession, for the people must rely upon their

physicians in all matters pertaining to the preservation of health and the prevention of disease. We can not expect that the active practising physician shall keep abreast of all modern advances in scientific medicine, and the numerous contradictory statements that have been made in regard to yellow fever have afforded full justification for skepticism on the part of such as aim to be conservative. While strong conservatism is to be commended, persistent skepticism is to be condemned. It is perfectly justifiable to refuse to receive statements that revolutionize our accepted ideas, so long as they are based upon the assertions of a single observer or a single set of observers, but when these observations have been confirmed by competent unbiased persons in different parts of the world, such statements must then be accepted as facts, just as we accept other statements in regard to history, geography and the sciences in general.

It is well known that a number of disease-producing animal parasites are never found in nature outside the body of a living host. They pass their whole existence first in one animal and then in another, alternately, being carried to and fro by means of biting insects, by the ingestion of infested food, etc. It is only necessary to consider here the group of parasites that is transmitted by the blood-sucking insects, such as the tick and the mosquito, the latter in particular. We know that the Texas fever of cattle is caused by an exceedingly minute microscopic parasite which spends its whole existence in bovines and in the tick. If cattle are kept free from ticks they can not contract the fever. Furthermore, the tick is now accused, and with good reason, of being the transmitter of relapsing fever. It is equally well known and proved beyond question that the mosquito transmits filarial infection and malarial fever to man. No one would

think of asserting in print to-day that malaria is contracted through exposure to night air, to unhygienic surroundings or by drinking the filthiest water, for such statements would justly be characterized as absurd. The renowned experiments of Sambon and Low in Italy, in 1900, showed conclusively that persons can live in the most pestiferous malarial regions and retain perfect health, so long as they protect themselves against the bites of mosquitoes. In the same year these observers shipped living malaria-infected mosquitoes from Italy to England, where they were applied to two persons in perfect health in a region where malarial fever is unknown. Within a short time both of them suffered typical attacks of malaria, during which the parasites were frequently demonstrated in their blood. Fortunately the various stages in the development of the malarial parasite in man and in the mosquito can be demonstrated with the microscope. We know that the phases it passes through in the insect are entirely different from its cycle of development in man, and no one has as yet succeeded in demonstrating the existence of this parasite elsewhere than in a living host. Such a demonstration is not necessary, for with our present knowledge we can explain all the known facts relating to the contraction and dissemination of the disease and we can insure absolute protection against it. We no longer attribute malarial infection to the inhalation of gaseous poisons emanating from swamps in the nighttime, or to bad water. We know that swampy places simply furnish breeding grounds for the malaria-carrying mosquito, which flies at night, and whose bite is necessary for the contraction of the fever. The insect must previously have bitten a person suffering with malaria, and an interval of at least a week must have elapsed, otherwise no infection can result. The recent brilliant discovery by Koch,

that apparently healthy negro children in the pestilential districts of Africa constantly carry large numbers of malarial parasites in their blood, explains the source from which the mosquitoes obtain these parasites; it also explains the relative immunity against this infection enjoyed by the negro.

If we now consider the numerous points of similarity between malaria and yellow fever they will be found to be very striking. Both are diseases of low-lying districts; both infections are contracted chiefly at night; both may be conveyed by direct inoculation of the blood of a patient; both are most prevalent in the places and seasons where and when mosquitoes are most numerous; both infections are impossible after severe frosts, which cause the mosquitoes to hibernate. These constitute strong points of resemblance between the two diseases, which differ from each other in that the duration of yellow fever is very short, while malarial infection may persist for years. Unfortunately, the parasite of yellow fever has never been found, in spite of claims to the contrary, and notwithstanding the use of the best powers of the microscope, and even the ultramicroscope, in the efforts of skilled observers to discover it. That there is a yellow-fever parasite we feel assured, because it is not possible to explain the continuous propagation of the disease upon any other hypothesis, and apart from its invisibility, the manifestations of its presence are in complete accord with the behavior of parasites that are well known. We must not forget that the minimal limits of creation in nature may be beyond our conception, and we must be prepared to learn, if necessary, that there are living bodies too minute to be defined with our present instruments.

The report of the latest scientific investigation of this disease by Otto and Neumann, of Hamburg,<sup>1</sup> members of the

German commission, working in Rio de Janeiro within the past year, states that they were totally unable to find anything either in the blood or in the cerebro-spinal fluid of patients suffering with yellow fever, that could not be found in similar material obtained from persons suffering with other diseases and from persons in good health. In this work they used the ultramicroscope of Siedentopf and Zsigmondy. Neither could they find anything in the infected mosquito after dissecting it in the fresh state, nor after hardening and sectioning it, that they felt justified in regarding as the cause of the disease.

How then are we to explain this failure to discover a parasite in an apparently parasitic disease? And, if a parasite be present, to what class does it belong? It seems quite rational to exclude it from among the bacteria because: (1) It has never been cultivated nor stained by any of our known methods; (2) the work of Marchoux, Salimbeni and Simond has shown that the blood of a patient after its withdrawal loses its power to infect within two days, if kept exposed to the air, and within five days if air be excluded; (3) the disease has been shown to be absolutely non-contagious in regions where *Stegomyia fasciata* is not present, *i. e.*, in Petropolis near Rio de Janeiro; (4) we know no bacteria that live in the tissues of animals, as the yellow-fever organism does in the mosquito, for months, as a harmless parasite. The logical conclusion, therefore, would seem to be that the parasite of yellow fever belongs to the animal kingdom, because: (1) It is absolutely necessary for its continued existence that it pass alternately through man and the mosquito, and its parasitic existence in these hosts is obligatory; (2) the fact that a period of about two weeks or more

<sup>1</sup> M. Otto and R. O. Neumann, *Zeitschrift f. Hygiene u. Infektionskrankheiten*, LI., 3, November, 1905.

must elapse before the contaminated mosquito is capable of infecting, points to a definite cycle of development in that insect; (3) the limitation of its developmental cycle to mosquitoes of a single genus, and to a single vertebrate, conforms to a natural zoological law and does not agree with our present knowledge of the life history of bacteria; (4) the effects of climate and temperature upon *Stegomyia*, and upon the rate of development of the yellow-fever parasite within the body of that insect, are exactly the same as the effects of the same conditions upon the *Anopheles* mosquito and the malarial parasite.

Consequently, although on account of its minute size no one has ever been able to identify the organism of yellow fever either in human blood or tissues, or in the mosquito, we feel justified in regarding it as an obligate animal parasite. If this be correct it can not maintain its vitality in water, in soil nor in any other material, no matter how badly they may chance to have been contaminated. Experience and experiments have shown that such is actually the case; that dead bodies can be freely handled and dissected by non-immunes without danger; that non-immune persons may live in intimate contact with the garments, bedding and clothing used and soiled by yellow-fever patients, under the same conditions and in the same climate where yellow fever has prevailed, and suffer no inconvenience. And further, it has been shown by the French commission that this organism fails to survive in blood, a most excellent culture medium, after it has been kept for forty-eight hours under ordinary conditions. This undoubtedly proves the inability of the organism to maintain its vitality in filth or decomposing organic matter.

Yellow fever is non-contagious, for in our medical literature numerous instances are

recorded where numbers of patients were brought to certain places for treatment and no secondary cases resulted. This was before the days of disinfection, before any precautions were taken against mosquitoes, and at a time when intercourse with the sick was free and unrestricted. These strange occurrences were observed in Spain during a severe epidemic at Barcelona in 1821, during which, under the supposition that the air of the city was infected, there was a general exodus to the country. Here hundreds came down with the disease and were treated, but not a single case was recorded to have appeared in a person who had not visited the city. Yet tons of furniture and baggage were carried from infected houses into the country. All this took place in a warm climate and during the ravages of a devastating epidemic. Such remarkable occurrences were inexplicable mysteries that puzzled the most brilliant medical minds of the day; they could only be explained upon the theory that the air of the city had become contaminated. And so it had, but not with poisonous gases and noxious vapors as they supposed, but with infected mosquitoes. In the light of the mosquito theory the explanation is clear. An epidemic prevailed in Havana during the early part of that season, and a number of cases appeared on vessels after leaving there for the Spanish port, where the epidemic appeared later in the season. The first cases in Barcelona were seen on the vessels from Havana, lying in the harbor; then persons living in the city, but who had visited or were employed on the vessels, were taken sick; and later, the epidemic raged throughout various parts of the city. It is quite evident that the vessels carried infected mosquitoes as well as others that were not infected; these mosquitoes bred rapidly in the houses on shore and the conditions then became

ripe for a rapid extension of the disease after the introduction of a few cases. It is to be noted that vessels were constantly arriving from Havana; cases appeared on the ships during the voyage, and, until suspicion was aroused, patients from the vessels were treated on shore. The *Stegomyia* introduced from the vessels, being house mosquitoes, remained in the city, while the country districts were free from them, and for that reason free from any extension of the fever. The absence of the proper mosquito is the only explanation that can be offered, and in the light of our present knowledge, it is all-sufficient.

In the United States, both before and since the epidemic at Barcelona, there have been similar outbreaks, always introduced by importation, though frequently regarded as of endemic origin, *i. e.*, at Philadelphia, Baltimore, Norfolk and New Orleans. In the latter city the danger is particularly great, because *Stegomyia*, being always present, will readily spread the infection if it encounter a sufficient number of non-immunes.

Another good case in point is Petropolis, twenty-five miles from Rio de Janeiro and at an elevation of 3,000 feet. Yellow fever is never known to occur there, spontaneously, and for that reason it has been made the home of non-immunes who spend the night at Petropolis and visit Rio during the day, for the transaction of business. While there are no *Stegomyia* at Petropolis, the French commission showed three years ago that the disease can be produced there by inoculation with infected insects. At the present day one who seeks can find abundant evidence to show not only that the mosquito transmits yellow fever, but that without the agency of the mosquito it is impossible to have yellow fever, except by means of experimental inoculations.

Since the first demonstration of the mos-

quito theory by the army board in 1900, confirmatory experiments have been made by Dr. John Guiteras of Havana, Ribas and Lutz of Brazil, the French commission from the Pasteur Institute, Working Parties No. 1 and No. 2 of the U. S. Public Health and Marine Hospital Service; and lastly the German commission from Hamburg, admit no other possibility. The latter, whose report was published only two months ago, lay great stress upon the necessity for the extermination of mosquitoes in localities where yellow fever appears in epidemic form, because, they say, without the mosquito, extension of the disease is impossible. They advocate complete extermination of the insect, and speak with enthusiasm of the success that has been attained in Rio, in spite of the opposition of a number of local physicians and of a rather large proportion of the population. As a result of their observations in Rio, they maintain positively that the natural form of yellow fever can be contracted only through the bite of an infected mosquito of the genus *Stegomyia*; they are so firmly convinced of this fact that they decline to consider the possibility of any other mode of infection, since they could find no evidence in support of it. They found the yellow-fever mosquito everywhere in the city of Rio, but in Petropolis, where the French commission before them could not find it and where yellow fever is known never to spread, they failed to discover a single specimen. If one could say the same of New Orleans another outbreak of yellow fever there would be an impossibility, except when the mosquito as well as cases had been introduced. According to Otto and Neumann,<sup>2</sup> the authorities in Rio are about to adopt the admirable system of providing a mosquito-proof barrack for laborers in the harbor and docks, and they will keep the men

<sup>2</sup> The German commission.

under medical supervision, in order that any cases occurring among them may be protected at once from mosquitoes. This will insure that no secondary cases shall be produced by infection from them. They urge the necessity for protecting patients from mosquitoes during the first three or four days of the fever, because it is only during this period that the mosquito can acquire the infection. They state emphatically that in combating an epidemic all preventive measures should be directed against this insect and its relation to the patient. After proper protection of the patient all suspected mosquitoes must be destroyed, and efforts should then be made to exterminate all *Stegomyia* present in the locality, if possible.

Under the efficient management of the director of public health, Dr. Oswaldo Cruz, who is himself an experienced scientist, over \$65,000 per month was expended in Rio de Janeiro, from April to December, 1903, in the war against mosquitoes. Even the main sewers were fumigated and myriads of mosquitoes destroyed in them by the use of sulphurous acid. A sanitary brigade was organized into sections for operation in the different districts into which the city was divided. The personnel of this brigade comprised about 2,000 men, including 80 physicians. Their duties were specifically defined as:

(1) The isolation of yellow-fever patients and their protection from mosquitoes, including the necessary arrangement of the isolation rooms; (2) the destruction of mosquitoes in the house and its surroundings and the destruction also of their breeding places; (3) the removal of the patient in a screened conveyance from his home to the hospital, if he desired it, or if it were impossible to isolate him in the house and the public interest demanded it.

All suspicious cases were treated as though they were cases of yellow fever and half-way measures were not tolerated.

A manifesto setting forth the relation of

the mosquito to the disease and the necessity for the measures instituted was published on April 26, 1903, for the instruction of the people, and I can not do better than cite a few extracts from it to show the positive conviction of those in authority, who had already witnessed the confirmatory experimental work of the French and Brazilian commissions.

#### EXTRACTS FROM THE MANIFESTO.<sup>3</sup>

2. Yellow fever is not conveyed from person to person, nor is it transmitted by means of soil, or articles used during illness, the sole means of transmission is by the mosquito, as has been fully determined.

3. Several days after biting a case of yellow fever the mosquito acquires the power to transmit the disease, and it preserves that power for some time, two and one half months or more. The domestic habits of the mosquito explain sufficiently why yellow fever is a disease that establishes itself in houses and why it is contracted only in cities.

8. During epidemics, when the disease is at hand, all healthy persons should have mosquito nets upon their beds at night, and they should take care not to be bitten by mosquitoes during the day, because yellow fever mosquitoes bite also in the daytime.

The new harbor regulations for vessels entering with yellow fever on board are in part as follows:<sup>4</sup>

(a) The sick are immediately removed and isolated with mosquito netting.

(b) The mosquitoes in the entire vessel are killed systematically and their breeding places are destroyed.

(c) Passengers who intend to stay in the harbor receive a health certificate and are subjected to medical supervision for twelve days.<sup>5</sup>

<sup>3</sup> J. Dupuy, 'Epidemiologie de la Fievre Jaune,' *Revue d'Hygiene et de Pol. San.*, Paris, 1905, XXVIII., 13-29.

<sup>4</sup> Otto and Neumann.

<sup>5</sup> This is based on the prolonged periods of incubation reported by Marchoux, Salimbeni and Simond, and is unnecessary, because it has never been shown conclusively that an incubation period

(d) The vessel is then admitted to free intercourse, but admits a health inspector on board, who will accompany the vessel to its last Brazilian port and who proceeds as follows: (1) He examines daily, with care, all the passengers and the crew, and isolates with netting any who show symptoms of fever. (2) If mosquitoes be present their immediate destruction is ordered at once.

\* \* \* \* \*

I have cited only a few paragraphs to show that the authorities have thoroughly grasped the situation and their ultimate success is assured. The gigantic nature of their undertaking in an unsanitary subtropical city of more than a million inhabitants can hardly be conceived, and their enlightened and determined efforts are exciting the admiration of the scientific world. With continued perseverance they will eventually attain the same degree of success that has been achieved in Cuba and their example will be followed by the smaller Central American republics.

After four years of immunity Cuba has been caught napping. According to the last report of the U. S. Public Health and Marine Hospital Service<sup>a</sup> she has had seventy cases of yellow fever, with fifteen deaths, between October 16 and December 17. Two of the cases were imported. According to the newspapers six additional cases have been reported up to December 25. While the condition is serious, there is no epidemic and the authorities have the situation under control. The large number of cases relative to the deaths reported shows that but few, if any, cases escape detection. I feel sure that the disease will

of more than six days and a few hours can follow a simple mosquito inoculation. In every instance in which a longer period of incubation is proved the subject received injections of either serum or blood. These observations therefore can have no practical bearing on measures directed against the natural infection which is produced by the mosquito alone.

<sup>a</sup>Public Health Reports, Washington, December 22, 1905, p. 2,739.

be eradicated within the next two months. One or two or a few cases may appear in the early spring because some of the infected mosquitoes may escape fumigation and survive through the short winter. There is no reason to apprehend, however, that Havana will again become seriously infected.

Although I am now two years beyond the half-century mark, I think I can reasonably expect to live to see the day when yellow fever shall have been exterminated from the whole American continent, and that means practically from the world. Let us hope that the beautiful city of New Orleans will never again be devastated by the American plague from which she has suffered so terribly and so often. The price of safety is eternal vigilance; the greatest danger from yellow fever lies in the escape of mild and doubtful cases. One of the first to apprehend the full import of the mosquito theory was Dr. Quitman Kohnke, and I can recall with what pleasure I listened in Washington, several years ago, to his able, courageous and masterful contention for it, before a rather unsympathetic audience.

In the sad experience here during the past summer, we have seen an effectual demonstration by the various officials under Doctor White of the efficacy of measures directed against the mosquito. With this and the evidence already brought forward by Guiteras and the French, German and Marine Hospital Service commissions, it should never again be necessary to contend for the well-proved fact that without the agency of mosquitoes there can be no yellow fever.

*Æstivo-autumnal Fever—Cause, Diagnosis, Treatment and Destruction of Mosquitoes which spread the Disease:* H. A. VEAZIE.

This fever interests the whole world, es-

pecially Texas, Louisiana, Mississippi, Alabama, Florida, and New Orleans in particular, as it has been and will be mistaken for yellow fever. I only hope that this second paper on this fever may at least save a few lives, and call the attention of physicians to its proper recognition, treatment and prophylaxis.

Synonyms: 'Summer-autumn fever,' 'pernicious malarial fever,' 'congestive malarial fever,' 'hemorrhagic malarial fever,' 'up-river yellow fever.'

*Geographical Distribution.*—This is a fever that prevails in nearly all parts of the world where the *Anopheles* mosquito is found, influenced to a greater or less extent by climate; a pseudo-epidemic fever that prevails in tropical countries the year round. In semi-tropical and temperate climates it prevails from about July 1 to frost. In some years it prevails as an epidemic in tropical and semi-tropical countries, this being due to conditions favorable to the *Anopheles* mosquito. The conditions favorable to mosquitoes are frequent, light rains, and a temperature of about 70° to 90° F. I am quite certain a lower temperature is not incompatible with its spread, as I have found in this city *Anopheles* quite active at a lower temperature, but frost seems to cause the hibernation of nearly all of our mosquitoes. Extremely dry hot weather is unfavorable to the breeding of mosquitoes of all kinds; hence there is not as much malarial fever in the heat of summer.

*History.*—The history of malarial fever dates back from the time almost beyond history. The physicians of Egypt in the time of the Pharaohs wrote of it. In some of my past reading, and I am sorry to say that I have forgotten where I noticed it, I read that a physician of Egypt, whose name was Mah, stated that malaria was a disease produced by a parasite in the blood, but the organism was so small that the human

eye was unable to see it. It was due to the labors of the immortal Laveran, a French army surgeon stationed at Constantine, Algeria, that the malarial parasite was identified and proven to be the cause of malaria (in 1880). Mechel in 1847 also described them, the ovoid bodies and pigment. Our own Professor Joseph Jones also did the same a few years later, he using the pigment as a means of diagnosis. He also shows quite a good rough sketch of malaria parasite in his 'Medical Surgical Memoirs.' It would be impossible for me to even read the names of men identified with the history of malarial fever. I must, however, mention Welch, Grasin, Councilman, Thayer, Manson, Young, Ross, Warner, Bastanelli, Golgi, Marchiafava, Celli and many, many others who labored hard and long to solve the malarial problem.

*Etiology.*—The cause of æstivo-autumnal fever is a parasite, a living micro-organism, a protozoon in the blood which enters the red blood corpuscles and destroys them, and in time is destroyed by the white blood corpuscles if the patient lives; otherwise, the destruction of the red blood corpuscles and toxins formed by the parasite kills the patient if proper remedies are not used, or if the white blood corpuscles are not sufficiently strong to overpower the parasites. Such cases are spontaneous cures. This parasite of æstivo-autumnal fever was studied extensively by Welch, and named by him the *Hæmatozoon falciparum*. I do not think that any one has yet completely settled its entire life history, as it seems most eccentric in its cycle of existence. A study of this alone would take years of patient work. However, the parasite is now well known and can be easily identified by proper staining, also in the fresh blood. A peculiarity of this parasite is that it seems to like to abide in the internal organs such as the liver, spleen, kidneys, bone marrow and

even the brain; hence, many of the cerebral symptoms. This parasite is the third form of malarial parasites. There may be a fourth form which causes what we now call yellow fever, and like many other diseases it may become obsolete as to name and possibly be classified as malarial. I have almost at times convinced myself that the two diseases were one and the same, but for the following reasons: in yellow fever there is no change in the number of red blood corpuscles; whereas, in malaria there is great change. In malaria the fibrin seems all right as to coagulative properties; in yellow fever the fibrin of the blood loses that important characteristic.

To get back to the æstivo-autumnal parasite: What does it look like? Where and how does it develop? Where does it come from? How did it get into the blood? With a one-twelfth oil immersion lens, the best working objective for blood work, we see in a red corpuscle in the first stage a very small ring-like refractive body which gradually gets larger and larger until the pigment is formed and the corpuscle is somewhat shrunken or crenated. The pigment increases preceding segmentation of the parasite and the formation of crescents and also before the escape of the parasite from the red blood cells and the throwing off of the flagella. The flagellæ enter other blood corpuscles and repeat the cycle of development, unless destroyed by the white blood corpuscles or by some anti-toxin or anti-malarial drug such as quinine or arsenic in the blood serum. Where this parasite comes from is hard to say. How, when or where the first case originated is still one of the mysteries of nature. How does the parasite get into the blood? This is now well understood. It is through the agency of the *Anopheles* mosquito, and in all probability the *Anopheles crucians*, as the prevalence of this fever

corresponds quite well with the flight and distribution of that mosquito. I would not consider this the only host for this parasite. Let us consider all mosquitoes as guilty, and destroy them at least for sanitary purposes. It is well known now that the mosquito bites an infected individual and the infected blood is taken into the stomach of the mosquito, there the blood is digested and the micro-organisms after going through certain changes, which are quite well known, form spindle-shaped objects which perforate the stomach walls. These are the zygocytes which go through different changes and finally get into the salivary glands of the mosquito, and are injected into the tissues of man's body, then in going through other series of changes produce the malarial parasite which we see in the blood of persons suffering from malarial fever. The various changes which take place in these bodies is quite well known, and almost any textbook on medicine describes the whole process minutely.

*Period of Incubation.*—It is not definitely known for this fever.

*Clinical History.*—This disease is usually ushered in with a chill of greater or less severity. The fever rises rapidly to 102° F., and as high as 105° F., even higher in bad cases. The pulse varies in different individuals from 100 to 160 per minute, and varies in various stages of the disease and condition of the patient. I have seen it as low as 40 per minute. Nausea, violent headache, backache and pains in the limbs usher in the disease. The fever usually declines at the end of ten hours and gradually disappears, possibly to return, or perhaps cured by nature or medication. If the infection is great or the patient is not taken care of, the fever assumes a more continuous character and many cases go into a state of collapse after a few days; the pulse in this case is slow and the

temperature low (subnormal). There is jaundice, with hemorrhages, albuminuria, black vomit, uremia, and death occurs in a manner very closely resembling that caused by yellow fever. The clinical charts vary as to pulse, respirations and temperature. The face and chest are quite red, the eyes congested—little photophobia—pupils about normal for amount of light present. Ophthalmoscopic examination of the retina shows it somewhat congested, the optic disk slightly so. The lips are somewhat red, during chill quite blue. The gums are usually normal or slightly red, except in bad cases, when they are spongy and bleeding. The tongue is somewhat broad, with yellowish coating, sometimes indented. There is tenderness over the stomach, liver and spleen both somewhat enlarged. Jaundice is usually noticed after the first day. The urine is increased in quantity, then diminishes, and often contains bile, albumin, casts and blood. The blood taken from the lobe of the ear or from finger-tips shows æstivo-autumnal parasites. In the year 1899 this fever was investigated by Dr. J. D. Bloom, then surgeon of the Charity Hospital of this city; Dr. O. L. Pothier, pathologist and bacteriologist of the Charity Hospital; Dr. G. S. Bell, visiting physician of the Charity Hospital; Dr. S. Y. Mioton, assistant pathologist of the Charity Hospital; Dr. Maurice Couret, assistant pathologist of the Charity Hospital, and the speaker. In every case we found the æstivo-autumnal parasite where the blood was examined. This was done in over a hundred cases. The blood of one hundred and thirteen persons (not ill) was examined out of that number, and eleven had the parasites in their blood, and on tracing the history of the eleven six had the fever and five were afterwards taken ill. I will now detail one of Dr. G. S. Bell's cases simulating yellow fever with

black vomit, ending in recovery, recorded by collaborators in the article published in the *New York Medical Journal*, May 19 and June 2 and 9, 1900, to which I would refer any one who wishes further cases, clinical charts, etc.

M. G. A boy sixteen years old, born in Bayou LaFouche, La., family history good; previous history good. Patient came to New Orleans two weeks before taking sick, but had been feeling bad for a while in LaFouche. Complaints of pains throughout the body, chilly sensations, impaired appetite, tired feeling, etc. On October 18, he was taken sick with fever, headache, no appreciable chill (no chill), vomiting, pains all over the body. The same symptoms continued the next day, October 19, 1899. Dr. G. S. Bell was called for the first time to see the patient on October 20, 1899, and found the following conditions: The patient was very nervous, restless and suffering with intense headache; eyes slightly jaundiced; stasis, but not very marked; gums slightly soft. He had profuse diarrhœa. It was stated that the patient had twenty actions from the bowels; they were watery but of natural color. Temperature was 104° F., pulse 120, respiration 40. Dr. Bell making a careful physical examination found heart normal, lungs normal, liver slightly enlarged, spleen distinctly enlarged and tender on palpation. On examination of the blood he found malarial parasites, urine contained two per cent. of albumin, hyaline casts, bile, no granular casts. Ordered five grains of bisulphate of quinine in water every three hours. October 21 (fourth day of illness): Temperature 102.4° F., pulse 112, respiration 32. Other symptoms about the same, malarial parasites still present in the blood. Urine contains two per cent. of albumin, bile, hyaline casts. Ordered five grains of bisulphate of quinine; continued every three hours. No other treatment. October 22 (fifth day of illness): Temperature 101° F., pulse 112. Patient vomiting black. He had black vomit three times while Dr. Bell was at his bedside. The blood still contains a few malarial parasites. The stomach being irritable, Dr. Bell stopped the quinine by mouth, and gave him five grains of bisulphate of quinine hypodermically every three hours and stopped all nourishment. He saw the patient twelve hours after; stomach was less irritable, vomiting had ceased; patient feels better. October 23 (sixth day of illness): Patient feels much better, temperature 100° F., pulse 80, respiration

28. Stomach in good condition. The patient retained five grains of bisulphate of quinine every three hours, also retained small quantities of milk. Jaundice did not increase. October 24 (seventh day of illness): Patient still improving and feels much better; stomach in good condition, temperature 100° F., pulse 78, respiration 24. October 25 (eighth day of illness): Temperature normal, 98½° F., pulse 60, respiration 20. October 26 (ninth day of illness): Temperature 98½° F., pulse 48; respiration 20. October 27 (tenth day of illness): Temperature 98.4° F., pulse 48, respiration 18, urine normal. Patient went on to uninterrupted recovery.

Dr. Bell's cases total fifty-five in number, carefully observed microscopically, physically and every way possible.

Total number of cases seriously ill, fifty-five; total number of cases which were very ill but not in danger of death, twenty-one; total number of recoveries, fifty-four; total number of mild cases, fifteen; only one death—all treated with quinine. Of the fifty-five cases, fifty-three were natives of New Orleans and lived in New Orleans up to the time of illness. One was born in New Orleans, but lived in LaFouche ten years. Of the fifty-five cases forty-eight cases occurred in forty-eight different houses; the remaining seven occurred, as follows: Two cases in one house; two in another. No family visited by Dr. Bell consisted of less than five members; seven had had yellow fever.

*Sex of Patients.*—Males, thirty-five; females, twenty. *Race.*—White, 50; colored, 5. We all had many cases of this fever, but I quote Dr. Bell's, as all records were bedside records carefully taken.

*Pathological Anatomy (gross).*—Autopsy No. 900. Lungs: right, twenty-three ounces; left, twenty-three ounces. Spleen: nine ounces. Pancreas: two ounces. Heart: fourteen ounces. Liver: eighty-four ounces. Kidneys: right, six ounces and one quarter; left, six ounces and one half. Body of white man slightly jaundiced about face and neck, conjunctiva yellow; pupils slightly contracted; post-mortem rigidly marked; heart, normal; lungs, œdematous; spleen, soft, muddy, enlarged and intensely congested.

*Liver.*—Fatty degeneration marked.

*Gall Bladder.*—Full. Pancreas, normal. Kidneys congested; granular, slight fatty degeneration.

*Diagnosis.*—From post-mortem, Dr. O. L. Pothier, pathologist; acute pernicious malarial fever.

*Microscopical Pathological Anatomy.*—In acute or primary cases there is slight or no pigmentation of organs, but the organs mostly infected are found full of malarial parasites, especially the spleen, the liver, kidneys and brain. I fear if I go too far in minutiae I shall tire you. In this æstivo-autumnal fever the patient is either dead or well before the usual evidences of malaria are produced. Hence, the finding of the crescent, or ovoid bodies in the various organs is the most reliable sign. Nearly every organ is in a state of congestion.

*Diagnosis.*—This disease in the first day or two can be confounded with almost any disease beginning with chill, fever and high temperature. If the patient lives in the country or suburbs the malady is likely malarial, as this fever usually occurs in the country or suburban districts. That is the case in this city; whereas, yellow fever usually starts in the older quarter, thickly populated districts near the wharves and shipping, and among newly arrived persons. The finding of the crescents or æstivo-autumnal parasites is proof positive that the patient has this fever beyond question. Whether it is a mixed infection or not is another question; it is possible but not probable. Sir John Hunter was right in a measure, but we do know that sometimes there occurs mixed infection—say, typhoid and yellow fever. At times malaria also complicates both of these diseases. Under these circumstances, the wisest and most astute physician may be puzzled. When you find the patient has the malarial parasite in the blood, he certainly has malaria, and very seldom anything else. The finding of the parasite is a certain indication of malarial infection. The test of Torti,

the giving of quinine, and if the patient recovers rapidly, show that it is simple uncomplicated malaria. If not, the test of Widal for typhoid and the Faget law for yellow fever until we find better means. The yellow fever parasite or *materies morbi* must be a parasite, but extremely small, and will be found in the fibrin or serum of the blood, or as a captive in the white blood corpuscles, as the red ones do not appear to suffer in numbers from yellow fever infection, but greatly so in all forms of malarial infection. So the diminution of red blood cells is a diagnostic factor and a very important one in malarial infection, and its absence in yellow fever helps us to separate the two diseases.

The presence of free pigment in the blood is also diagnostic of malarial fever, and was greatly relied upon by my honored and respected preceptor, Professor Joseph Jones, M.D., of the medical department of the University of Louisiana—now medical department of the Tulane University of Louisiana. I am in hopes that the organism recently found by my friends of the Charity Hospital and Emergency Hospital, of which very little has been written, will prove to be the cause. This organism is still *sub judice*, and I would prefer that they describe it, as to them is due the honor of discovery. I hope at last that the long-sought-for yellow-fever organism has been found. We must wait, however, for more proof—the greatest of honors to the man or men who find it, as it has long been sought. The malarial patient is more quiet, not as alert as the yellow-fever one. The eyes are not watery in malarial patients, though they may be red. The yellow-fever eye is pink rather than red and watery—‘like a person who has been exposed to irritating smoke.’ The malarial eye is not so bright. The yellow-fever eye actually shines in the first twenty-four or forty-eight hours, then may get

dull. I think Faget’s law is quite characteristic of yellow fever, but is not certain by any means, as charts of æstivo-autumnal fever do show the same want of correlation. A positive diagnosis can hardly be made of yellow fever to differentiate it from malarial fever, unless the malarial parasite is found; and Torti’s test with quinine is positive, when we should conclude that the patient had malarial fever and not yellow fever. Still he might get well in spite of the quinine or other treatment, even if he had yellow fever, so it is best to treat sanitarily all cases of fever by screening, at least with a bar to protect them and others from mosquitoes, even if it is malarial. Bile, albumin and casts in the urine, so long thought characteristic of yellow fever, are often found in æstivo-autumnal fever. A point which was brought most forcibly forward by an old physician of this city was this: He said in years gone by they did not question the diagnosis of yellow fever, but when an epidemic of fever would break out, they would ask one another: Does quinine break the fever this year? I think that is quite significant as to the close resemblance of the two fevers when it comes to clinical evidence alone, and with the means at hand of the older physicians—no microscopical knowledge, no record of temperature. The only guides for them were those gained by inspection and taxis. The pulse, as we know, gives some help, but little, however, when these two diseases are to be diagnosticated one from the other. We have made but little advance, however, in our means of positive diagnosis. It is more positive as to malaria, and when the æstivo-autumnal parasite is found the cases are ninety-nine in one hundred malarial, and quinine will cure them. I could write pages of symptoms, such as peculiar facial expression of yellow-fever patients; the

tongue, odor, etc., but none are at all reliable.

*Treatment.*—In the alkaloids of Peruvian bark we have the specific quinine given in the form of the bisulphate or chlorid. The older form (sulphate) does not seem to kill so effectually or quickly this form of malarial parasite, because, for some reason, it is not absorbed; if so it may not have sufficient solubility to affect the parasite. I have been in consultation with physicians, and they have said that this disease can not be malarial, as I have given large doses of quinine, and the patient did not improve. They were giving the sulphate in capsules, and the patient did not absorb it. I give the bisulphate of quinine in capsules, and perforate each capsule at each end just before administering it. If you perforate the capsule some time before administering, the quinine sifts out and the patient gets the bitter taste. If the stomach is so irritable that the quinine is rejected, then give, per rectum or hypodermically, either the bisulphate or the chlorid dissolved in sterilized water. Fifteen or twenty grains daily are usually sufficient, except in malarial coma when I give more. I gave as much as one hundred and twenty grains of the sulphate by rectum, some years ago, when I did not know of the utility of the bisulphate. When giving the hypodermics insert the needle deep into the thigh or arm, and abscesses are not so liable to occur. Fifteen to twenty grains in twenty-four hours is effectual, continued until you can medicate by mouth. I usually give in the ordinary cases a simple purge, such as calomel and soda followed by a saline purge, or simply a seidlitz powder, citrate of magnesia, in fact any purge is efficient. Then push the quinine in doses of fifteen or twenty grains daily until the fever is gone. The patient must be kept in bed and under the influence of an antiperiodic for at least twenty-eight

days, or the multiple of seven, as there are usually four generations of parasites to get rid of. The diet should be liquid during the febrile stage (soups, milk and broths); solids should be given gradually; plenty of water such as vichy and other alkaline drinks are desirable. Mortality of this fever is practically nothing, if properly treated and cared for. If not, then you have a most fearful condition of affairs, and you can imagine yellow fever or most anything else. What means should be instituted by communities to prevent this disease from spreading? Our esteemed friend and collaborator, Dr. J. H. White, makes the assertion that yellow fever can not be introduced into a community except by a sick person. It is the same with this fever. The mosquito in both instances must be infected from a person infected; otherwise, its sting is simply painful for a few minutes and conveys no disease. Consequently quarantine against freight is useless and harmful to all concerned. It is the sick person we must look out for; the infected person.

Sanitary measures necessary to prevent the spread of this disease are the same as those for yellow fever. Screen the patient, destroy all mosquitoes and their breeding places; have no mosquitoes and we will have no malária or yellow fever in our midst. When making extensive improvements either in a city or country, observe this well, as it is very important from a sanitary standpoint. In these improvements the previously existing drainage natural in the country, artificial in cities, is usually interfered with and stagnant water accumulates and mosquitoes breed. Therefore, see that no still or stagnant water exists. The greatest friend we have is the little minnow, the top minnow or *Gambusia affinis*. This little creature abounds in nearly all southern states, and is one of the greatest enemies to the mosquito, so cherish

them and have them in ponds or undrainable accumulations of water. Screen your cisterns, or water tanks; salt your gutters, as was done by Dr. J. H. White, in this city last summer. Two and one half per cent. solution is sufficient, or oil them with kerosene as has been suggested and done by Dr. L. O. Howard. Both methods are extremely successful as I have seen in this city during the past summer. It was thought by our citizens that we could not get rid of mosquitoes, but it was certainly done by Dr. J. H. White and the citizens of this city. The past summer was the first summer that I can remember having slept without a mosquito bar, and many thousands in this city can say the same. The *Stegomyia colopus*, which is the correct name, as I am lately informed by Dr. L. O. Howard, was hard to find after the measures were adopted. I had hard work to find them for experimental work; before this summer I could go into any house, and get all I wanted. I tried in every way to see if I could get larvæ by the usual method of placing uncovered receptacles holding water, and for two months no larvæ appeared. I have not seen any stegomyia in my house since the screening and work done for their extermination. The anopheles mosquito, or malarial mosquito, breeds in the swamps or large ponds where there are no minnows or fish; so, drain, fill, stock them with numerous fish, salt or oil them.

The destruction of infected mosquitoes in homes, ships, etc., is best done by culicides. Sulphur kills them and other insects, but is so destructive to things such as furniture, delicate fabrics, etc., that people will not use it; pyrethrum is expensive and does not kill; it simply stupefies. Dr. J. H. White, knowing these difficulties, appointed a committee to investigate culicides. This committee was composed of the following members: Dr. J. H. White,

president; Dr. Rupert Boyce, vice-president; Dr. Donald Currey, Dr. W. H. Perkins, purveyors; Dr. Q. Kohnke, Dr. H. A. Veazie, secretaries.

The committee, after trying various substances, tried the culicide of Mr. J. C. Mims, the analytical chemist of this city, and chemist to the city board of health. This culicide was first used by him to kill mosquitoes, after years of experimenting with various substances. He tried equal quantities of gum camphor and crystallized carbolic acid, and found that it was most effectual as a culicide, and I am quite certain it is a most excellent germicide, as it should be theoretically and as has been shown in some recent experiments. This culicide is made of equal quantities by weight of carbolic acid and gum camphor; the crystals of the carbolic acid being melted by gentle heat and poured over the camphor, and the clear liquid colored blue, by methylene blue, simply for safety's sake, and the liquid volatilized by heat. The vapors kill all insects, mosquitoes most effectually, and destroy or injure nothing whatsoever except animate things. This culicide and disinfectant was used most extensively last summer in the most elegant houses, Pullman cars and ships with the most satisfactory results. Every imaginable insect, such as mosquitoes, flies, roaches, etc., was killed by it, and nothing whatsoever, except living things, injured. The expense of this culicide is between that of sulphur and pyrethrum. It is far better than either. It is safe when properly used, and kills insects from the top of the room to the floor, when used in proper quantities, three ounces to the thousand cubic feet. All broken panes of glass must be covered and pasted, ventilations closed, and fireplaces of room closed up so that none of the vapor escapes. The only trouble was that connected with generators, which had to be effectual and safe, as the

liquid is somewhat inflammable but not explosive.

I have constructed a generator which answers all purposes and is safe. I am in hopes of having them made in quantities, so that if necessary, this culicide can be used extensively. It is absolutely certain that this culicide and disinfectant injures nothing but living things—the most delicate fabrics, metals, etc. I would be pleased to give any information to any one as to its efficiency. For lack of time, I can not speak further of this most wonderful agent.

I thank you all for your kind attention.

WILLIAM J. GIES,  
*Secretary.*

#### SECTION B—PHYSICS.

THE annual meeting of Section B, Physics, of the American Association for the Advancement of Science, was held in the Physical Laboratory of Tulane University, in New Orleans, on December 29 and 30, 1905, and on January 1, 1906. The presiding officer was the vice-president of Section B, Professor Henry Crew, of Northwestern University. The other officers in attendance were the retiring vice-president, W. F. Magie; the secretary, D. C. Miller; member of the council (no election); member of the general committee, H. T. Eddy; members of the sectional committee, Henry Crew, W. F. Magie, D. C. Miller, A. Trowbridge (elected at this meeting to serve for five years), E. L. Nichols and F. E. Nipher; press secretary, J. R. Benton.

It was decided by the general committee that the next annual meeting would be held in New York City in convocation week, 1906-7; and that those sections desiring to do so might hold a summer meeting in Ithaca in the latter part of June. The desirability of such a meeting for Section B will be determined by letter ballot. The presiding officer for these meetings will be

the vice-president elect, Professor W. C. Sabine, of Harvard University. The other officers for these meetings, so far as now determined, are:

*Retiring Vice-President*—Henry Crew.

*Members of the Sectional Committee*—W. C. Sabine, Henry Crew, D. C. Miller, A. G. Webster, G. F. Hull, F. E. Nipher, E. L. Nichols, A. Trowbridge.

*Secretary*—Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

On December 31 the retiring vice-president, Professor W. F. Magie, of Princeton University, gave a most interesting address on 'The Partition of Energy'; this address was printed in full in SCIENCE for February 2, 1906.

Because of mutual interest in the papers offered in Sections B and D, and because the programs were short, two joint sessions of these sections were held. The program of papers presented is given below, with abstracts of all but one of those belonging to Section B; the abstracts of the other papers will be given in the report of the secretary of Section D. There was ample time for full discussion of the papers, and advantage was taken of this opportunity, adding much to the enjoyment of those attending.

Although the attendance was small (there were about thirty-five present at each meeting), yet the quality of the meetings in every respect was quite up to the average, and all were unanimous in expressing the opinion that the sessions had been both profitable and enjoyable. Excursions to the pumping and drainage stations, to a sugar plantation and mill and to a sugar refinery, as well as the miscellaneous attractions peculiar to New Orleans as a city, were greatly enjoyed by those in attendance.

*An Experiment on Easterly Deviation Beneath the Earth's Surface:* F. W. MACNAIR, Michigan College of Mines.

During the investigation of the cause of divergence of long plumb lines hung in the No. 5 shaft of the Tamarack Mine<sup>1</sup> attention was drawn to the old Cornish method of plumbing a shaft by dropping a spherical shot, the vertical being assumed as the line joining the point of suspension with the point of striking at the bottom. A rough calculation of the probable easterly deviation which might be expected of a body dropping from surface to the foot of the lines, forty-two hundred feet, led to the announcement that it was in the neighborhood of four feet. This is obtained by taking the difference in velocity between points on the two cylinders about the earth's axis, one including the small circle of latitude and the other that through the foot of the plumb lines, and multiplying by the seconds allowed for the fall.

A deviation admitting of consistent measurement in feet was impressive enough to create a demand for an opportunity of witnessing it, and an experiment was devised to gratify this desire. It was performed at the close of a certain day's 'plumbing' in No. 5 shaft and consisted in suspending a steel sphere by a thread at the collar, getting it as quiet as possible, then burning the thread while observers below watched for its striking a prepared clay bed.

It was a little over five feet from point suspension of sphere east to shaft timbers. In a vacuum between sixteen and seventeen seconds would be occupied in the fall. The ball failed to appear at all.

Another sphere hung in the center of the shaft compartment about three feet from the eastern timbers, when dropped, also failed to appear below. Afterward a sphere, presumably this one, was found lodged about eight hundred feet from sur-

face. Further experiments were not then feasible.

Crude as was the whole proceeding and devoid of serious purpose, it yet drew the attention of those concerned to the possibilities offered by the deep vertical shafts of the copper district of Michigan for the investigation of easterly deviation.

The author suggests that an accurate mapping of the path of a falling body beneath the surface might possibly afford interesting data bearing on the distribution of the earth's matter. He hopes at a subsequent time to present a properly elaborated plan of investigation of this path.

*A Device for producing an Instantaneous Arc at any Phase of an Alternating Current:* HENRY CREW, Northwestern University.

The essential features of this instrument are as follows: (1) A pair of electrodes, one of which has a motion of pure translation; the other, a motion of pure rotation. (2) The rotating electrode is driven on the shaft of a synchronous motor. (3) The arc is fed by the same transformer which drives the motor. (4) The phase of contact between the moving electrode and the fixed one is read off on a divided circle.

The object of this device is to obtain a comparatively cold (?) carbon arc in the neighborhood of zero-phase. The region between the poles of a continuously operated carbon arc shows no carbon bands, in its spectrum, at zero phase. But a carbon arc of the type indicated above shows the carbon bands at the lowest phases that can be examined, say, from 0° to 2°. The explanation of this difference lies probably in the fact that, owing to the greater heat, the current of the continuous arc at small phases is carried by the *ions of the metallic impurities*; while in the discontinuous (or instantaneous) arc the conduction is made

<sup>1</sup> See SCIENCE, Vol. XV., page 994. Also *Engineering and Mining Journal*, April 26, 1902.

possible by ionization, by incandescence, of carbon, the incandescence being secured by Joule heat.

*Distribution of Gas Pressure in a Closed Tube Rotating on a Transverse Axis:* FRANCIS E. NIPHER, Washington University. (To be published in the *Transactions of the Academy of Science of St. Louis*.)

The paper is a mathematical discussion deducing the pressure at the axis, and showing that it is independent of the length  $l$ , and angular velocity  $\omega$  of the tube, if the velocity  $v = \omega l$  is constant. The pressure at any other point is also determined, in terms of its distance  $r$  from the axis of rotation.

The pressure at the free end of the tube due to rotation is greater than the external pressure against the tube due to its motion through the external air. If the outer end terminates in an  $L$  with open mouth exposed to the air through which it is advancing the air within the tube is forced out in the teeth of the wind. If the tube be also opened at the axis, the air will pass out in a current through the open end of the  $L$  at the free end of the tube.

*A New Type of Frequency Meter:* A. S. LANGSDORF, Washington University. (To be published in *The Electrical World*.) Section D.

*Report of Progress in Experiments on Ether Drift:* EDWARD W. MORLEY and DAYTON C. MILLER, Cleveland.

At the Philadelphia meeting an account was given of experiments to detect ether drift. The observations indicated that there is no drift of the ether. It has been suggested that the negative result was due to the influence of the heavy stone walls of the building within which the apparatus was mounted. The interferometer has since been mounted on high ground near

Cleveland and covered in such a manner that there is nothing but glass in the direction of the expected drift. Observations, though difficult, have been made; but cold weather interrupted them before a definite conclusion had been reached. The observations are to be completed at the first opportunity in the spring of 1906.

*A Critical Analysis of Methods of Supplying Power to Branch Telephone Exchanges on the Common Battery:* KARL KINSLEY, University of Chicago. Section D.

*A New Form of Mercury Still:* CHARLES T. KNIPP, University of Illinois.

This still makes use of the mercury vapor lamp. In it are found, roughly, conditions necessary for the purification of mercury, such as heat by the passage of the electric current, and a more or less perfect vacuum. By fusing to the mercury vapor lamp a properly shaped condensing chamber, mercury of a high degree of purity may be obtained. The electrodes of the apparatus are mercury and are in communication with two vessels containing the supply mercury through narrow tubes about 80 cm. long. The condensed mercury flows from the still through a long capillary delivery tube bent in the form of an S at its lower end. The action of the mercury dropping into this tube is that of a continuous mercury pump. The apparatus is initially exhausted by means of a power Geryk pump (or other equally effective pump). The are is started by employing a side connection as described by Weintraub.<sup>2</sup>

In this form of still the rate of distillation is about one pound per hour, and the cost is approximately one cent per pound.

To test the action of the still zinc amalgams were used. The test for zinc was

<sup>2</sup> *Phil. Mag.*, Vol. VII., February, 1904.

made by the electromotive force method recently described by Hulett and Minchin.<sup>3</sup>

One millimeter deflection of the galvanometer corresponded approximately to .0005 volt. The results are given in the following table:

No.	Zinc Amalgam.	Distillate from Zinc Amalgam.	Defl. of Galv.
2a	1 : 700,000	—	2.17 mm.
5	—	1 : 3,000 approx.	1.51 "
3	—	1 : 10,000 "	1.69 "
100	1 : 370,000	—	4.00 "
a	—	1 : 1,740	.61 "
b	—	1 : 1,740	-.19 "
c	—	1 : 1,740	.55 "

From the above a deflection of 1 mm. corresponds to the presence of zinc in the ratio of 1:1,500,000. In numbers 5 and 3 the degree of zinc impurity was known only approximately, and since there was also present some lead and tin little weight should be given these results. In numbers a, b and c the ratio of zinc to mercury was definitely known. The distillate from this zinc amalgam condensed in three separate condensing chambers showed practically no trace of zinc. The mercury against which the above was balanced in the test cell was carefully and repeatedly purified by the 'wet' method. The degree of purity indicated above was altogether unlooked for, since the physical conditions in the still-temperature, vacuum, etc., are such as favor the vaporization of zinc too, and hence we should naturally expect zinc present to a more or less extent in the distillate. The result seemingly points to a suppressing action exerted by the electric forces upon the zinc ions. This phase of the phenomena is the subject of further inquiry.

*Difference in the Coefficient of Discharge of Steam through a Single Orifice and through a Number of Orifices near Each*

<sup>3</sup> *Phys. Rev.*, Vol. XXI., December, 1905.

*Other:* D. S. JACOBUS, Stevens Institute of Technology. (To be published in the *Transactions of the American Society of Mechanical Engineers.*) Section D.

*Note on the Distribution of Energy in Fluorescence Spectra:* EDWARD L. NICHOLS, Cornell University.

The fluorescence spectra of solids and liquids are, so far as known, confined to the visible wave length. Observers in this field of optics have until very recently contented themselves with a description of the appearance of the fluorescence band or bands and an indication of its approximate limits towards the red and violet. Professor Merritt and the present writer have, however, succeeded in making spectrophotometric measurements of the fluorescence of numerous substances and have published curves in which the distribution of intensities of fluorescence spectra are expressed in terms of the intensities of the corresponding wave lengths in the spectrum of the acetylene flame.<sup>4</sup>

By means of measurements of this source of light made by G. W. Stewart and independently by W. W. Coblentz, using a mirror spectrometer with rock salt prism and a radiometer, a curve showing the distribution of energy in the visible spectrum may be plotted. The writer<sup>5</sup> has published in a recent paper a curve based upon these data which gives the distribution of energy in the acetylene flame and has checked the values thus obtained by means of spectrophotometric comparisons between the Hefner and the acetylene flames and Angström's curve for the distribution of energy in the spectrum of the Hefner flame.

This curve makes it possible to convert the spectrophotometric curves for the fluorescence of any given substance into curves of the distribution of energy in its

<sup>4</sup> Nichols and Merritt, *Physical Review*.

<sup>5</sup> Nichols, *Physical Review*, Vol. 21, p. 147.

fluorescence spectrum and enables us to secure data for this distribution in the case of spectra the intensity of which is far too weak to admit of direct measurements of the energy. In the present paper such curves for four typical fluorescent solutions, sulphate of quinine in water, fluorescein, rhodamin and chlorophyll in alcohol (together with the energy curves of the absorption spectra of these substances), are presented. These curves and a discussion of their properties will be published in the *Physical Review*.

*Conditions Which Change the Resistance of the Selenium Cell:* F. C. BROWN, University of Illinois.

The paper reviews the conditions that produce change in the electrical resistance of the selenium cell—those that produce a remarkable change such as is not found in any other element:

Light, which changes the resistance as much as ten times.

Heat, which changes the resistance almost as much as does light.

Hydrogen peroxide decreases the resistance thirty per cent. when the selenium is placed three cm. from the surface of the liquid.

Increase of E.M.F. in the circuit may decrease the resistance as much as 1,000 times.

Hydraulic pressure decreases the resistance even more than sixty per cent. The accompanying curves show how uniform is the effect of pressure. The cells used were, in general, patterned after those of Bidwell.

In five of the curves which were shown, for three different cells, the pressure coefficient is quite constant, as is shown by the following approximate values:

- .00103 ohms per gram pressure.
- .00105 ohms per gram pressure.
- .00120 ohms per gram pressure.
- .00109 ohms per gram pressure.
- .00107 ohms per gram pressure.

Other conditions which produce minor changes of resistance according to different investigators are: X-rays, radium rays, Hertzian waves, ozone treated caoutchouc.

The following data for one of the selenium cells at low temperatures seem to show that the resistance is not much different from ordinary room temperatures, and that the sensitiveness to light is about three times as great:

Resistance—ohms.	Temperature deg. Cent.	16 c.p. lamp 8 cm. from cell.
86,000.....	— 61 .....	off
82,000.....	— 60 .....	off
97,000.....	— 60.8 .....	off, room darkened
110,000.....	? .....	off
110,000.....	? .....	off
114,000.....	? .....	off
114,000...	— 58 to — 60.8 ...	off
21,000.....	— 58 .....	on
17,000.....	— 55 .....	on after 2 min.
17,000.....	— 53 .....	on after 4 min.
15,800.....	— 57 .....	on after 6 min.
15,700.....	— 61 .....	on after 8 min.
15,600.....	— 61 .....	off
25,600.....	— 61 .....	off after 1 min.
26,800.....	? .....	off after 5 min.
28,400.....	— 58 .....	off after 7 min.
32,000.....	? .....	off after 17 min.
33,000.....	? .....	off after 19 min.
45,000.....	— 28 .....	off after 45 min.
75,000.....	— 10 .....	off after 55 min.
119,000.....	room tem. ....	off after 5 hrs.

Those conditions which decrease the resistance very much probably do so for the same reason.

The theory that has been most generally accepted as to the cause of decrease of resistance, is that of Bidwell. He said that it was due to a selenide which was found more or less in every selenium cell, and which made the cell a better conductor when the light fell upon it. Up to the present time, we are not at all assured that a selenide plays any important part.

Another theory has been given, namely, that light produces crystallization, and since some kinds of crystals conduct better

than others, the change of resistance is due to the formation of crystals in unstable equilibrium.

Another theory is that in the selenium cell there is a form of selenium called metallic, which conducts electricity well and which is a sort of solution with the non-conducting selenium. Light causes the metallic selenium to make better contact and thereby reduces the resistance.

As selenium has a coefficient of expansion about five times that of ordinary metals, the author was led to the study of pressure effect, thinking that the change of resistance might be due to contact differences. But this is, at present, only a theory.

*Elastic After-effects in Crystals:* J. R. BENTON, Geophysical Laboratory of the Carnegie Institution.

The elastic properties of solid bodies vary with different specimens of the same substance, and in the same specimen when it is subjected to varying preliminary treatment. There is reason to believe that the discrepancies are due to irregularity of structure, such as is known to exist in metals and many other solids. If this explanation is correct, there should be no irregularity in the elastic behavior of single crystals. To test this, experiments were planned for observing the elastic after-effect, elastic hysteresis and permanent set, in crystals. The present paper describes the first part of these experiments, which deals with elastic after-effect. Observations were made on the torsion of mica, and on the flexure of selenite, kunzite and rutile; they show that the elastic after-effect is not entirely absent, as was hoped would be the case, but is very small as compared with that in most solids. The reason why it appears at all probably lies in the fact that absolutely perfect crystals can not be secured for the experiments.

*The Percentage Bridge:* A. C. LONGDEN, Knox College.

Five or six years ago, a paper entitled 'A Percentage Bridge' was presented to the American Association for the Advancement of Science, and also to the American Institute of Electrical Engineers, by Mr. H. C. Parker, of Columbia University.

The instrument as described by Mr. Parker is essentially a four-gap slide wire bridge in which the two inner gaps are used for the comparison of resistances, and the auxiliary resistances in the outer or end gaps have such a relation to the resistance of the bridge wire that a change of a hundredth of one per cent. in the ratio of  $R_1$  to  $R_2$  shall produce a change of one millimeter in the position of the balancing point on the bridge wire. The test coil, however, is not balanced directly against the standard, but one of the resistance gaps,  $R_1$ , for example, is used as a substitution gap, and a standard resistance in this gap is balanced against a resistance approximately equal to it, and then the test coil is *substituted* for the standard and the bridge is again balanced. The distance in millimeters on the bridge wire between the two balancing points indicates the difference between the two coils in hundredths of one per cent.

This method seems to have a number of real advantages over the Carey Foster method for comparing standard resistances.

The simplicity of the percentage method is greatly in its favor and ought at least to entitle it to serious consideration. It does not *eliminate* the resistance of the end connections, nor does it necessarily make them so *small* as to be negligible, but it makes the total value of the end resistances so *large* that even if they differ by a hundredth of an ohm, the error in the result will only be one part in twenty million!

A mercury commutator is suggested for

substituting one coil for another in the percentage bridge, which is less complicated than the Carey Foster commutator.

The most serious disadvantage of the percentage method is pointed out and a remedy suggested.

The percentage bridge is an instrument of great simplicity, great sensitiveness and relatively great range; and one in which the standard resistances are automatically protected from heavy currents. It is not only a very superior instrument for the comparison of standard resistances, but one which lends itself admirably to a variety of special purposes, such as calibrating rheostats, determining temperature coefficients, etc.

*Priming Caused by Poor Circulation in a Boiler:* D. S. JACOBUS, Stevens Institute of Technology. Section D.

*Dual Degree for Engineering Courses:* P. C. NUGENT, University of Syracuse. Section D.

*Panama: Discussion of Present Conditions and the Prospect:* F. L. WALDO. Section D.

*Panama: A Sea-Level Canal:* W. R. WARNER, Cleveland. Section D.

DAYTON C. MILLER,  
*Secretary.*

#### THE SOCIETY FOR PLANT MORPHOLOGY AND PHYSIOLOGY.

THE ninth annual meeting of this society was held, in conjunction with the meetings of the Western Branch of the American Society of Naturalists and the Affiliated Scientific Societies, at the University of Michigan, Ann Arbor, Mich., December 27, 28, 29, 1905, under the presidency of Professor E. C. Jeffrey. Though small in point of numbers, the meeting was otherwise one of great profit and enjoyment.

In effect it was a joint meeting with the Botanists of the Central States, for this society held sessions only in the mornings and the Botanists of the Central States only in the afternoons, each society attending the sessions of the other. The new members elected were Messrs. Mel. T. Cook, of the Agricultural Experiment Station of Cuba, Raymond H. Pond, of Northwestern University, and W. W. Stockberger, of the United States Department of Agriculture. The society voted to accept the constitution recommended by its committee on union of botanical societies in case it is accepted by the Botanical Society of America and the American Mycological Society, and on this basis to unite with those societies into a single new society to be called the Botanical Society of America. Pending the action of the other societies no new officers were elected, but the officers of this meeting were continued until the union of societies should be effected, or until the next annual meeting, with authority to perfect all details of the union. The address of the president, entitled 'Morphology and Phylogeny' has appeared in full in SCIENCE. The society expressed by a special vote its great appreciation and thanks for the gracious hospitality of the university, and for the admirable arrangements of the local committee, which contributed so much to the interest and success of the meeting.

Since the Ann Arbor meeting the Botanical Society of America and the American Mycological Society, at their meetings at New Orleans, have taken action with respect to a union of botanical societies similar to that taken by this society at Ann Arbor. Accordingly a union of these three societies into a single society of the widest scope has been agreed upon and is expected to be brought into effect during the present year. The Ann Arbor meeting, therefore, was the last to be held by this society

separately; next year it will meet in New York, as part of the new society.

The papers presented before the meeting were the following. All were presented in full and discussed. The abstracts are by the authors.

*The Induction of New Species:* Dr. D. T. MACDOUGAL, Carnegie Institution.

The author described some experimental researches by which forms, potentially new species, were secured as a result of chemical and osmotic action exerted on unfertilized ovules. Solutions were injected into the ovaries of *Raimannia* immediately previous to pollination and fertilization, which then apparently ensued in a normal manner. Among the seeds secured were a number which produced plantlets, differing from the normal, or typical of the species, notably in physiological qualities and general anatomy. Some of the atypical derivatives thus secured had come to maturity and produced seeds, and are to be considered as mutants of the parental type. The series of experiments demonstrates conclusively that factors external to the protoplast may exert a profound influence upon its hereditary characters, and call out qualities not hitherto exhibited externally by the line of descent affected.

The author had not yet succeeded in analyzing the manner in which the treatment described had influenced the normal activity of the embryonic cells, but suggested that the readiest explanation lay in the suggestion that the externally applied reagents had interfered with the normal course of the succession of the enzymes during the stages immediately preceding egg-formation, and also that the results were indicative of unequal influence upon individualized chromosomes.

*Some Factors Concerned in Color Production in a Species of Fusarium:* Dr. J. B. POLLOCK, University of Michigan.

The species of *Fusarium* used was obtained from the cut ends of Indian corn stubble, in autumn. One of its characters is the bright salmon-pink color usually found under natural conditions. This color also develops on many artificial media, under proper conditions. Among the conditions necessary for its development, direct sunlight, or at least strong light, is of primary importance. Diffuse light is scarcely any better than complete darkness. In absence of light only a pale cream color is produced, generally without the faintest tinge of red.

Cultures removed from diffuse light to direct sunlight showed a marked development of color within five hours.

Moisture also has a considerable influence on the development of color. The moister the medium the less the color shows, but even submerged in a liquid medium there may be some color produced in light. Besides light and moisture, the composition of the medium also influences the production of the red color. Under similar conditions of light and moisture, after seven days' growth, the red color was very pale on cornstarch, while on carrot, hubbard squash and cornmeal the color was between roseous and testaceous of Saccardo's color chart; on apple, onion and potato it was almost exactly ochraceous, on wheat flour it was slightly paler than orange, and on buckwheat flour it was darkest red, slightly redder than testaceous.

On raw dahlia tubers the growth becomes bright red, but if they are steamed in the autoclave almost no red color is produced even in the light. Also on steamed dahlia tubers the fungus produces a green color, and this was produced on no other medium used. All the soft tissue of the medium turns green, and on some cultures the fungus growth above the surface is

green also. The green color is produced in both light and darkness.

*The Traumatic Reactions of Living and Extinct Araucarians:* Professor E. C. JEFFREY, Harvard University.

Among the Abietineæ *Abies* and its allies, although possessing normally no resin canals in the secondary wood, form traumatic resin canals as the result of injury. The presence of resin canals as a constant and normal feature of the first woody ring of the root in *Abies*, etc., as well as their occasional occurrence in the first annual ring of the vegetative and reproductive branches of the stem, leads to the inference that the traumatic resin canals of the abietoid Abietineæ are a reversionary feature. The examination of a considerable number of species of the living araucarian genera *Dammara* (*Agathis*) and *Araucaria* has resulted in the conclusion that the living Araucarineæ do not produce traumatic resin canals. The present author has been able to extend this conclusion to certain extinct Araucarians from the Cretaceous beds genera *Dammara* (*Agathis*) and *Araucarioxyla* of the Cretaceous beds of the eastern United States, however, show a very different wound reaction from that found in *Agathis* and *Araucaria*, for they form traumatic resin canals very abundantly as a result of injury. These occur in the usual tangential rows characteristic of traumatic canals and contain mucilage as well as resin, as is commonly the case in the cortical resin-canals of the living Araucarineæ. The *Araucarioxyla* which react in this way are characterized by the small size of their tracheids and the complete absence of the resin-containing elements, which are found in the wood of living Araucarineæ. There is good reason to believe that these *Araucarioxyla* are the wood of *Brachyphyllum* Brongniart, which thus

takes its place among the Araucarineæ and in that most ancient group, which includes *Walchia*, *Ullmannia*, *Pagiophyllum*, etc. Traumatic resin canals have been found in araucarioxylous material from the Raritan formation of Staten Island, from Martha's Vineyard and from the much older deposits of the Potomac. The writer is of the opinion that these facts will turn out to be of considerable phylogenetic significance.

*Some Experiments in the Control of Color in Plants:* Dr. HENRY KRÆMER, Philadelphia College of Pharmacy.

In a paper presented to this society a year ago the author gave the results of some morphological and chemical studies on the color substances of plants. An examination of a large number of the unorganized or cell-sap color substances showed that they readily react with various chemicals, a marked change in color being produced in many instances. For example, the majority of plant-color substances turn green with calcium hydrate, deep red with organic acids, rich purple with potassium and aluminum sulphate, and blue with ferrous sulphate. While the color substances in plants are considered to be in the nature of metabolic products, still it is likely that the various tints and shades are due to certain associated substances, as organic acids, phosphates, calcium salts, etc.

It has been repeatedly observed in the study of certain chromogenic bacteria that the intensity of the pigment is dependent in great measure upon the nutrient media used. The addition of chemicals like magnesium sulphate, potassium phosphate and grape sugar, is found to be necessary for the development of the pigment. Overton found some years ago that by feeding certain plants with glucose there was an increase in the red coloration of the leaves. Katic has recently published some observa-

tions on this subject. He has fed plants with cane sugar, potassium, calcium and magnesium salts, and reports that he has obtained positive results. He, however, adds that other factors must be taken into consideration, as the presence of oxygen, exposure to light and the maintenance of a certain temperature.

Certain more or less fanciful notions have heretofore prevailed with regard to the influence of chemicals on the color of flowers. The blue-flowered form of *Viola lutea* has been supposed to owe its color to the presence of zinc in the soil. The blue color in flowers of hydrangea has been attributed to the presence of an excess of iron or alum in the soil, and it is a common practise among rose growers to treat the soil with a solution of ferrous sulphate for intensifying the color of red roses.

About November 1, 1904, through the courtesy of Dr. George T. Moore, the author began a series of experiments in the greenhouses of the U. S. Department of Agriculture at Washington, for the purpose of determining the effects of certain chemicals on the color principles of plants. The plants selected for study were carnations, roses and pansies. The following chemicals were used: Aluminum and potassium sulphate, aluminum phosphate, aluminum sulphate, aluminum and ammonium sulphate, iron and ammonium sulphate, iron citrate, iron salicylate, iron malate, iron succinate, ferrous sulphate, potassium cyanide, potassium hydrate, potassium nitrate, potassium iodide, water of ammonia, ammonium nitrate, acetic acid, citric acid, formic acid, malic acid, salicylic acid, phosphoric acid, sulphuric acid and iodine.

The work thus far must be regarded as more or less preliminary, as the experiments showed that it is necessary to establish control conditions in order to determine the effects of the chemicals supplied, apart

from other factors. Some effects have already been noted, but these could perhaps be ascribed to other factors than the chemicals used. For instance, in the case of La France roses the petals became of a uniform pink color when the plants were supplied with iron citrate and citric acid. Maroon roses became dark red when the plants were supplied with phosphoric acid, iron and ammonium sulphate or sulphuric acid. In fact, the color of the maroon roses approached that of the crimson roses when treated with sulphuric acid, and they also tended to singleness.

*Channels of Entrance and Types of Movement in Bacterial Diseases of Plants:*

Dr. ERWIN F. SMITH, United States Department of Agriculture.

Using the blackboard for purposes of illustration, the speaker discussed the various ways in which bacteria enter the living plant, viz., through wounds and through natural openings. The question whether there is ever any entrance of the bacteria except through tissues injured by other causes was also discussed. It is still, perhaps, a matter of doubt whether in case of certain stomatal infections which take place when drops of water stand on the plant for a long time, there may not be suffocation of a few cells in the substomatic chamber prior to the multiplication of the bacteria. Such, however, does not appear to be the case, and certainly in water-pores, where the tissues are accustomed to be bathed in excess of water an infection conditioned exclusively on preliminary suffocation would seem to be improbable. The writer obtained rather promptly, viz., within a few days, numerous small, round, dead spots on cotton leaves sprayed under tents with water and then with pure cultures of *Bacterium malvacearum*. But these spots, which he regards as genuine

suffocation spots, did not enlarge much, did not contain any organisms, and bore no relation whatever to the genuine bacterial infection spots which appeared in great numbers some weeks later on these same plants, and passed through the typical stages of the angular leaf-spot. The author has since learned from Mr. W. A. Orton that similar sterile spots occur naturally on cottons in the field in rainy seasons. Attention was then called to the various mechanical obstacles which the bacteria meet with in the plant, and the methods by which these are overcome, to wit, by growth: (1) through vessels; (2) through parenchymatic tissues by way of the intercellular spaces, with the eventual formation of cavities; and (3) from cell to cell without the primary occupation of the intercellular spaces. The transpiration stream appears to have little to do directly with the movement of bacteria in the stems of diseased plants. It appears to be made out with reasonable certainty that in some cases bacteria pass from cell to cell through pits or thin places without crushing the cell-wall or dissolving any great portion of it. Such would seem to be the manner of movement of *Bacillus amylovorus* in some tissues of the pear. The writer spoke of the fact that new leaf-spot diseases due to bacteria are constantly turning up, the latest one being a disease of the Gloire de Lorraine begonia, cultivated in hothouses for winter blooming. Some observations were also detailed respecting the curious distribution of starch in young potato tubers diseased by *Bacterium solanacearum*. This organism, as is well known, has very little diastasic action on potato starch. The irregular distribution of the starch in such tubers seems to point, therefore, not to a solution of starch grains already laid down in the amyloiferous tissue, but to the paralysis or death (by enzymic action or other-

wise) of considerable areas of tissue surrounding the bacterial foci, so that it is impossible for the plant to lay down starch in such cells. Sections of such tubers from paraffin infiltrated material show the starchless areas to be roughly proportionate to the size of the central bacterial focus; if this is large, *i. e.*, of some age, there will be a correspondingly large area of the surrounding tissue which is destitute of starch grains or which bears them only in occasional cells. If the bacterial focus is a small one, the area destitute of starch will be correspondingly reduced in size. In tubers infected after they have reached a greater age the starch grains are present, and even in the center of a bacterial focus remain undissolved, and, so far as can be determined microscopically, are not corroded even on their margins by the action of the organism.

*Report from the Committee on the College Entrance Option:* Presented by Professor W. F. GANONG, Smith College.

A committee of the Society for Plant Morphology and Physiology, the present members of which are Professors W. F. Ganong and F. E. Lloyd, was appointed in 1900 to formulate a college entrance option in botany. The committee has published three reports, well known to members; and the course there formulated, based upon earlier educational reports and the approval of a large number of the prominent teachers of botany throughout the country, has been adopted by the college entrance examination board and by a large number of schools. The committee had been continued as a standing committee of the society with instructions to keep the option in touch with educational advance, and from time to time to report such alterations as may seem desirable. In the present report the committee stated that it had been gathering evidence as far as

possible upon the working of the option. The only serious criticism that has developed has been with reference to the number of topics, which has been found by most teachers to be too great for the time the option is supposed to take (one year). The committee accordingly recommended the omission of certain minor topics which will render it about one tenth shorter than at present, and improvements in certain minor details. These changes will soon be published in the *Plant World*, and will be laid before the college entrance examination board. The committee also called attention to the fact that although many schools now offer this full-year course in botany, comparatively few students take the college entrance board examination in that subject. This is obviously due to the fact that few colleges as yet include a year course of botany among their entrance options, and this, no doubt, largely because the existence of a definite highly-graded course in that subject has not yet been brought officially to the attention of the authorities. The recommendation was made by the committee that the members of the society who are teachers should at least make sure that the matter is not going by default in their own institutions.

*The Formation of Tetraspores in Grifithsia*: Professor D. S. JOHNSON and Mr. I. F. LEWIS, Johns Hopkins University.

The tetrasporangia are borne in whorls at the junction of two cells of the thallus. Each tetrasporangium rudiment arises as a papilla-like outgrowth from the apical region of the cell of the thallus. By a horizontal division this outgrowth gives rise to two cells, a basal stalk cell and a terminal tetrasporangium. The tetrasporangial cell increases in size and the nucleus divides into two, then into four, the nuclei lying peripherally in the cell. The

nuclei then travel toward the center of the cell, and simultaneously partitions grow in from the periphery. The four nuclei lie in a central mass of rather dense cytoplasm, the partitions just reaching the outer border of the central mass. In this condition the tetrasporangium is shed, the actual separation of spores taking place in the water.

*The Curly Top or Western Blight of the Sugar Beet*: Dr. C. O. TOWNSEND, United States Department of Agriculture.

This paper consisted of a discussion of twenty-three theories that have been investigated during the past five years, relative to the cause of the curly top or western blight of the sugar beet. The theories discussed included parasites, unfavorable soil, climatic and cultural conditions, inherent tendencies in the plant toward the disease, and a weakened condition of the plant due to poor seed. None of the theories investigated gave positive results in regard to the cause of the disease under the conditions in which the experiments were conducted. The bacterial theory has probably received more attention than any other possible cause of this disease, but the results thus far indicate that none of the organisms isolated are the sole cause of curly top. In some localities the disease is accompanied by insects so persistently that at first sight they seem to be the cause of the trouble, but their almost total absence from other badly diseased fields throws considerable doubt on this theory. The fact that a parasitic fungus was found in the tissues of the roots in several microscopic sections cut from diseased plants, points to this theory as one that needs further investigation. However, inoculations made with this fungus in healthy plants in the field and in the greenhouse have not produced the disease under the conditions employed. It is possible that a combination of un-

favorable conditions is necessary to produce the curly top. The most important practical result obtained so far in the study of the disease is the fact that it does not usually attack beets in the same locality or even in the same field two years in succession.

About twenty lantern slides were used to illustrate the paper.

*Distribution of Upland Plants near Ann Arbor:* Dr. G. P. BURNS, University of Michigan.

The physical features of the country around Ann Arbor are largely the result of glaciation. The region is made up of morainal ridges between which are numerous valleys. In some cases the depression forms a 'pot-hole.' These are filled with swamp or bog flora.

The soil conditions vary as much as the topography. The glacial deposits are different in various parts of the same section.

Large contour maps were made and on them the exact locations of the various plant societies plotted. These maps show that our hills are covered with hydrophytic and mesophytic as well as xerophytic plants.

The factor of greatest importance in determining the distribution of upland plants in this region is the position of the impervious layer.

*Demonstration of the Geotropic Sensitiveness of the Elongating Zone of Roots:* Professor F. C. NEWCOMBE, University of Michigan.

The well-known work of Czapek claimed to demonstrate the limitation of the perception of gravitation to the apical 1.5 mm. of the root-tip. The present report was divided into two parts, (1) arguing that Czapek had neglected to take account of the inherent tendency of roots to grow straight, and hence had failed to prove the localization of geotropic sensitiveness; and (2) exhibiting a preparation of twelve

seedlings of *Vicia faba* that had just been removed from a centrifuge revolving for six hours with a speed about four times the acceleration of gravitation. From each root 3 mm. of the tip had been removed six hours before, and yet all but one of the roots showed distinct outward curves, the bends being within 2 to 4 mm. of the ends of the roots.

There seems no escape from the conclusion that the elongating zone is sensitive to gravitation.

*On the Erroneous Physiology of Elementary Botanical Text-books:* Professor W. F. GANONG, Smith College.

The author pointed out that the recent simplification of methods and appliances of plant physiology accompanying its extension into elementary education, while admirable in some respects, had often resulted in crude, slipshod and illogical apparatus manipulation and reasoning. Various examples of erroneous experiments current in the elementary text-books, especially connected with photosynthesis, root-absorption and transpiration, were described. These errors have arisen partly from a neglect of control experiment, partly from a too-great reverence for the authority of very fallible leaders in simplification. The remedy is to be found in the application to elementary experimenting of the same logical and control methods we should use for investigation, in concentration upon a few important experiments rather than in spreading over many of a more showy type, and in the use of more exact and workman-like apparatus which it is often more economical to buy than to make. The paper will soon appear in *School Science and Mathematics*.

*The Growth-energy of Trees as Measured by the Bands of the Common Bagworm:* Dr. HERMANN VON SCHRENK, United States Department of Agriculture.

The common bagworm (*Thyridopteryx*

*ephemeraformis*) weaves a band of silk around the smaller twigs of many trees about the beginning of September. The cocoons remain on the trees over winter and in the great majority of cases drop to the ground in May or June of the following year, because the bands which hold them are torn as the twig increases in diameter. Now and then, however, the bands are so strong that they act as a ligature, causing the swelling of the tissues on one or both sides of the band. The swellings on the upper and lower sides usually join after several years, imbedding the band completely. Swellings were described and shown on soft maple, sycamore, red gum, oak, Virginia pine, sassafras, red cedar, arbor-vitæ, apple, robinia, deodar cedar, willow, cottonwood, cypress.

Several hundred bands were broken to test their strength, and the radial pressure which they exerted on the twig was calculated. As most of the bands are broken by the growth of the twigs every year, these bands were taken as a measure of the energy exerted by the twig. The pressure necessary to break them was determined to be about 35-45 atmospheres per square millimeter. Under pressures of 20-30 atmospheres the cambium still forms wood cells, which differ from the normal wood in having thicker walls, and a smaller lumen. A smaller number of vessels are formed. The results are considered as preliminary and more extended data were promised.

W. F. GANONG,  
Secretary.

NORTHAMPTON, MASS.

#### SCIENTIFIC BOOKS.

*Allgemeine Biologie.* Zweite Auflage des Lehrbuchs 'Die Zelle und die Gewebe.' Von OSCAR HERTWIG. Pp. 649, mit 371 Abbildungen im Text. Jena, Gustav Fischer. 1906.

This book is a second edition of 'Die Zelle

und die Gewebe,' which originally appeared in two parts, the first dealing with the general morphology and physiology of the cell, in 1892, and the second dealing with the cell in heredity and development, in 1898. Since the publication of the first part fourteen years have elapsed, and eight years since the publication of part two. These have been very fruitful years in the history of the subjects with which Professor Hertwig deals; conceptions of the morphology and physiology of the cell, current at the time of the first edition, have in some cases been greatly enlarged by new discoveries, and in other cases entirely superseded. Facts and ideas of prime importance concerning the chemistry of protoplasm, the so-called tropisms, the phenomena of cell-division, of maturation, fertilization, the physiology of development and the origin of species, have been set forth by numerous writers. The value of the present book must, therefore, be measured largely by the author's assimilation of the new data and by their incorporation within his original system in a logical manner, or else by logical development of a new system rendered necessary by the new data.

Let us see to what extent the new edition measures up to these requirements: (1) The number of pages of the new edition is 649, and of the two parts of the first edition 610; the number of figures has been increased from 257 to 371. There has been, therefore, considerable expansion; in many places new matter has replaced the old, entire sections have been completely rewritten, new sections have been added and there has been a certain amount of rearrangement. The main additions are Chapter IV., dealing with the conception of causation as applied to biology, part of Chapter VIII., dealing with problems of karyokinesis, and most of Chapter XI., dealing with the maturation phenomena of ova and spermatozoa. (2) On the other hand, the author has not attempted to incorporate any of the results of the chemistry of proteids or of the applications of physical chemistry to the study of protoplasm, although there is a chapter on the chemistry of the cell; he has not availed himself of any of the literature

since 1891 in the chapter on the phenomena of irritability (Ch. VII.), although a large part of the most important literature, on the theory of tropisms especially, is more recent; and he has not included any of the data concerning cell-lineage or germinal localization in the parts dealing with the theory of embryonic development, although (or because) these data render his own point of view untenable.

In general, then, though the author has included some of the new literature on certain subjects with which he deals, there are grave omissions of data necessary to the discussion of other subjects with which he also deals. It would be unreasonable to expect an exhaustive treatment of the vast field covered by general biology, and no criticism is due for the omission of certain problems entirely; it is due, however, for the omission of the most significant data in subjects actually discussed.

Professor Hertwig occupies precisely the same theoretical ground that he did at the time of the publication of the first edition. He declares himself in advance against all purely physico-chemical conceptions of the cell (pp. 15 and 16), "since they are fundamentally irreconcilable with the conception of the elementary organism, which runs through this text-book like a red thread." This point of view constitutes at the same time an apology for an inadequate and antiquated treatment of the chemistry of protoplasm. Most biologists will no doubt agree with the author that 'protoplasm is a biological conception,' not a name for a simple chemical substance, and that, even if the chemist could synthesize all kinds of proteids, he would still be far from the synthesis of an organism; but most would value more highly than does the author the contributions from the physico-chemical side to our comprehension of protoplasm.

The second part of the book is essentially a theory of ontogenetic development with its phylogenetic implications; it was originally published as a separate work in 1898, and was reviewed at that time by the present writer.<sup>1</sup> The second edition contains very little matter

that was not included in the first, and the theoretical standpoint is exactly the same; so that the review of the first edition might serve equally well for the second. The author believes in the inheritance of acquired characters, and adopts a Lamarckian point of view in regard to evolution, without seriously examining the difficulties or availing himself of new data; for instance, de Vries' 'Mutationstheorie' is not mentioned, though it bears a date of publication three years earlier than Hertwig's book. Similarly on the side of ontogeny the author finds the full and sufficient explanation of development in the multiplication of cells and in their manifold relations with the environment, again without serious examination of the difficulties and with scant respect for important recent literature.

What was really needed was not a second edition, but a new book, for which Professor Hertwig either had no leisure or lacked realization of the need. It is unfortunate that he should have permitted himself to issue a second edition under such circumstances.

FRANK R. LILLIE.

#### SCIENTIFIC JOURNALS AND ARTICLES.

*The Journal of Infectious Diseases*, Supplement No. 2, February, 1906. Some of the papers presented to the laboratory section of the American Public Health Association at the Boston meeting, September 25, 1905:

WILLIAM HALLOCK PARK: 'Some Observations upon the Agglutination of Bacteria.'

EDWARD K. DUNHAM: 'Comparative Studies of Diplococci Decolorized by Gram's Method, Obtained from the Spinal Fluid and from the Nares of Cases of Epidemic Cerebro-Spinal Meningitis.'

MARY E. GOODWIN and ANNA I. VON SHOLLY: 'The Frequent Occurrence of Meningococci in the Nasal Cavities of Meningitis Patients and of Those of Direct Contact with Them.'

OSKAR KLOTZ: 'Temporary Alteration of Character of an Organism Belonging to the Colon Group.'

H. L. RUSSELL and C. A. FULLER: 'The Longevity of *Bacillus Typhosus* in Natural Waters and in Sewage.'

GEORGE C. WHIPPLE and ANDREW MAYER, JR.:

<sup>1</sup> SCIENCE, N. S., Vol. VIII., No. 198, 1898.

'On the Relation between Oxygen in Water and the Longevity of the Typhoid Bacillus.'

GEORGE A. JOHNSON, WILLIAM R. COPELAND and A. ELLIOTT KIMBERLY: 'The Relative Applicability of Current Methods for the Determination of Putrescibility in Sewage Effluents.'

GEORGE A. JOHNSON and A. ELLIOTT KIMBERLY: 'A Comparative Review of Current Methods for the Determination of Organic Matter in Sewage.'

A. ELLIOTT KIMBERLY and M. G. ROBERTS: 'A Method for the Direct Determination of Organic Nitrogen by the Kjeldahl Process.'

A. ELLIOTT KIMBERLY and HARRY B. HOMMON: 'The Practical Advantages of the Gooch Crucible in the Determination of the Total and Volatile Suspended Matter in Sewage.'

H. W. CLARK: 'The Resistance to Decomposition of Certain Organic Matters in Sewage.'

STEPHEN DEM. GAGE and GEORGE O. ADAMS: 'The Collection and Preservation of Samples of Sewage for Analysis.'

ERNEST C. LEVY: 'A Ready Method for Preparing a Silica Turbidity Standard.'

GEORGE C. WHIPPLE and ANDREW MAYER, JR.: 'The Solubility of Calcium Carbonate and Magnesium Hydroxide and the Precipitation of These Salts with Lime Water.'

GEORGE C. WHIPPLE and FRANCIS F. LONGLEY: 'Experience with the Use of a Nonbasic Alum in Connection with Mechanical Filtration.'

H. W. CLARK and S. DEM. GAGE: 'The Use of Copper Sulphate in Water Filtration.'

H. W. CLARK and STEPHEN DEM. GAGE: 'On the Bactericidal Action of Copper.'

FRED B. FORBES and GILBERT H. PRATT: 'Notes in Regard to the Determination of Copper in Water.'

HIBBERT WINSLOW HILL: 'A Notable Source of Error in Testing Gaseous Disinfectants.'

FRANCIS H. SLACK: 'Methods of Bacteriological Examination of Milk.'

HIBBERT WINSLOW HILL: 'Suggestions for Change in the Schedules for Making Broth, Gelatin and Agar, Recommended in the Last Report of the Committee on Standard Methods of Water Analysis.'

HIBBERT WINSLOW HILL: 'A Device for Filtering Toxins, etc., by the Use of Water Pressure.'

#### SOCIETIES AND ACADEMIES.

##### THE AMERICAN MATHEMATICAL SOCIETY.

The one hundred and twenty-seventh regular meeting of the American Mathematical

Society was held at Columbia University, on Saturday, February 24, 1906. Professor W. F. Osgood, the president of the society, occupied the chair. Thirty members attended the meeting. The council announced the election of the following nineteen persons to membership in the society: Mr. M. J. Babb, University of Pennsylvania; Mr. William Betz, East High School, Rochester, N. Y.; Mr. G. D. Birkhoff, University of Chicago; Mr. W. D. Breuke, Harvard University; Mr. B. E. Carter, Massachusetts Institute of Technology; Dr. H. L. Coar, University of Illinois; Miss Anna Johnson, Harvard University; Mr. W. D. Lambert, U. S. Coast Survey; Mr. W. A. Luby, Central High School, Kansas City, Mo.; President W. J. Milne, New York State Normal College; Professor Richard Morris, Rutgers College; Mr. W. J. Newlin, Harvard University; Miss R. A. Pesta, Wendell Phillips High School, Chicago, Ill.; Dr. H. B. Phillips, University of Cincinnati; Mr. A. R. Schweitzer, University of Chicago; Mr. C. G. Simpson, Michigan College of Mines; Mr. A. W. Stamper, Columbia University; Mr. F. C. Touton, Central High School, Kansas City, Mo.; Mr. M. O. Tripp, College of the City of New York. Ten applications for membership were received.

The following papers were read at the meeting:

W. H. BUSSEY: 'On the tactical problem of Steiner.'

IDA M. SCHOTTENFELS: 'On linear fractional transformations of functions of the complex variable  $u + \epsilon v$ , when  $\epsilon^2 = 0$ ' (preliminary communication).

C. J. KEYSER: 'On the linear complex of circle ranges in a plane.'

E. B. WILSON: 'Note on integrating factors.'

MISS R. L. CARSTENS: 'A set of independent postulates for quaternions.'

W. B. FORD: 'On the analytic extension of functions defined by double power series.'

OSWALD VEBLEN: 'Remark on a measure of categoricity.'

VIRGIL SNYDER: 'Surfaces generated by conics cutting a twisted quartic curve and a line in the plane of the conic.'

CLARA E. SMITH: 'Development of a function in terms of Bessel's functions (second paper).'

L. P. EISENHART: 'Surfaces with the same

spherical representation of their lines of curvature as spherical surfaces.'

PAUL STÄCKEL: 'Die kinematische Erzeugung von Minimal-flächen (erste Abhandlung).'

OSKAR BOLZA: 'A fifth necessary condition for a strong extremum of the integral  $\int_{x_0}^{x_1} F(x, y, y') dx$ .'

A regular meeting of the San Francisco Section of the society was also held on February 24, at Stanford University. The next meeting of the society will occur on Saturday, April 28. The Chicago Section will hold its nineteenth regular meeting on Saturday, April 14, at the Northwestern University Building, Chicago. The date of the next annual meeting of the society has been fixed as Friday and Saturday, December 28-29. The summer meeting and colloquium will be held at Yale University during the week September 3-8. A preliminary announcement of the colloquium lectures will be issued in May.

W. H. BUSSEY,  
*Assistant Secretary.*

#### THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 612th meeting was held on January 27, 1906.

Mr. Briggs concluded his communication on 'Centrifugal Methods of Soil Investigation,' pointing out as a third use, to extract the liquid contents of a sample of soil, and fourth, to determine capillary flow of water through soils.

Mr. W. W. Coblentz, of the Bureau of Standards, then presented by invitation a paper on 'The Infra-red Radiation of Gases.' This part of the spectrum has been investigated by photography to  $1.2\mu$  and by phosphorescent plates to  $1.7\mu$ ; beyond this point the thermopile, bolometer and radiometer have been used up to  $15\mu$ . The speaker had used an unusually sensitive form of the last-named instrument. He exhibited in ten charts the distribution of radiation from various bodies; as a 'black body,' burning gases, a Welsbach mantle, metals in the carbon arc and gases in a vacuum tube.

Previous investigations on emission lines had extended to  $2\mu$ . He had noticed that this was the limit of the lines predicted by our spectral series formulæ, hence the object of

his investigations was to determine whether emission lines could be found beyond this region.

The main points shown were that inert gases like helium and nitrogen have strong lines just beyond the red, while CO and CO<sub>2</sub> have a strong emission band at  $4.75\mu$ . He showed that for gases in a vacuum tube all lines increase in intensity with increase in current, keeping the pressure constant. On the other hand, for constant current and variable pressure the emission lines at  $1\mu$  have a maximum intensity at about 1.5 mm. pressure, while the intensity of the  $4.75\mu$  band does not pass through a maximum. From this he concludes that the lines at  $1\mu$  belong to those in the visible spectrum, while the  $4.75\mu$  band is not thus related, but seems to be of a thermal instead of an electrical origin. For the arc between metal electrodes and for the salts of the metals in the carbon arc he found no lines beyond  $2\mu$ . Another interesting point was that the violet vapor of the carbon arc has no infra-red emission lines except possibly at  $1\mu$ .

Mr. J. F. Hayford then exhibited the new Swiss 'Millionaire' multiplying machine and discussed the speed and limits of accuracy in practical computing of approximate written multiplication, the slide-rule, logarithms, Crelle's table and machines. The new machine, unlike the familiar Thomas-Burkhardt type, requires both multiplicand and multiplier to be set up; but then a single turn of the crank is enough for each figure of the multiplier even though the figure be 9. In practise only about half as many manual operations are required as on the older machine.

Each of the papers gave rise to considerable discussion.

THE 613th meeting was held on February 10, 1906.

President Abbe brought forward informally the problem 'How is the peculiar noise associated with a meteor passing through the upper air produced and communicated to us?' No adequate solution has yet been given.

Mr. F. B. Littell described in detail 'The New Transit Circle of Kiel Observatory' of

eight and one half inches aperture, made by Repsold, and having many novel features. It is mounted in a double-walled semi-cylindrical dome with shutter ten feet wide; the masonry piers have means for observing their stability. The tube is of steel and is shielded. There are three objective screens to reduce all stars to the same magnitudes; a reversion prism and the new transit micrometer are provided. Novel provision is made for determining the errors in collimation, azimuth and level, from flexure and irregularity of pivots, and in graduation of the circle. Mr. Updegraff spoke of the history of such instruments and stated that the first steel-tube transit was made under direction of Professor Harkness in 1889. Messrs. Hayford and Abbe defended the accuracy of the spirit-level when properly used.

Mr. L. W. Austin then spoke on 'The Emission of Negative Particles Produced by the Impact of Canal Rays on Metals.'

In the work described an attempt was made to find whether the positively charged canal rays which pass backward through a perforated cathode in a vacuum tube give rise to reflected rays when they come in contact with a metal plate connected to earth. No reflection of the canal rays was discovered, but it was found that the impact gave rise to an emission of negative corpuscles. Like the well-known negative emission produced by cathode rays this emission increases with the angle of incidence of the canal rays, being about two and one half times as great at  $70^\circ$  as at perpendicular incidence. The negative corpuscles appear to have some considerable velocity, but how great this velocity is has not been determined.

CHARLES K. WEAD,  
Secretary.

#### THE ONONDAGA ACADEMY OF SCIENCES.

The academy held its regular monthly meeting in Syracuse on February 16.

Miss M. L. Overacker spoke of 'A Few Devonshire Ferns,' and exhibited material collected in England during the past summer. Among other ferns, particular interest was expressed in the abundance of *Asplenium Rutamuraria* L. and in the abundance and

variability of *Phyllitis Scolopendrium* (L.) Newman.

Mr. George T. Hargitt also presented a paper on 'Regeneration and Growth,' an abstract of which follows.

A preliminary report of a series of experiments which was started at Woods Hole during the past summer, to determine the conditions necessary for regeneration and growth. The animals so far studied include several species of hydroids and the medusa *Gonionemus*. The results obtained show the effect upon regeneration of acid and alkali, and also of various salts, especially those found in the sea water. These solutions and salts were added to normal sea water and also to a synthetic sea water.

The general results suggested were as follows: Acids have a tendency to retard or inhibit regeneration, while alkalies have a tendency to accelerate regeneration. Both acids and alkalies may sometimes act as disturbing rather than as definitely accelerating or retarding stimuli. The effect of these and other chemical stimuli is largely dependent upon the state of vitality and sexual maturity of the animals. Calcium and potassium seem to be necessary for regeneration and growth, but may be present in variable quantities, especially the calcium.

The experiments will be continued during the present year.

J. E. KIRKWOOD,  
Corresponding Secretary.

#### THE CALIFORNIA BRANCH OF THE AMERICAN FOLK-LORE SOCIETY.

The sixth meeting of the California Branch of the American Folk-Lore Society was held in the Unitarian Church, Berkeley, on Tuesday, February 13, 1906, at 8 P.M. Mr. Charles Keeler presided.

The minutes of the last meeting were read and approved.

The following persons approved by the council were elected to membership in the society, the secretary being instructed to cast the vote of the society for them: Mr. F. Rossi, San Francisco; Professor O. M. Johnston, Stanford University.

Dr. William Popper delivered a lecture on 'Superstitions of the Arabs,' based on his researches and personal experiences among the Arabic-speaking peoples of the Orient.

One hundred and thirty-five persons attended the meeting.

A. L. KROEBER,  
*Secretary.*

#### THE BERKELEY FOLK-LORE CLUB.

THE third regular meeting of the Berkeley Folk-Lore Club during 1905-6 was held in the Faculty Club of the University of California on Wednesday evening, January 31. President A. F. Lange presided, Professor W. F. Bade acting as secretary *pro tem*. Dr. W. Popper and Dr. A. W. Ryder were proposed for membership in the club and unanimously elected. Professor G. R. Noyes presented the paper of the evening on 'Servian Heroic Ballads.' Mr. Nikolitzsch, who was present as the guest of the club, read one of the ballads in the original. The paper was discussed at length by the members.

A. L. KROEBER,  
*Secretary.*

#### DISCUSSION AND CORRESPONDENCE.

##### ISOLATION AND THE EVOLUTION OF SPECIES.

I HAVE read with the greatest interest the discussion on isolation and its relation to evolution, commencing with President Jordan's article in *SCIENCE* for November 3, 1905.

There are many reasons for believing that in the earlier stages of the segregation that produces two or more species from one, geographical isolation, or at least some degree of local isolation, has had in many cases an influential part. It is, however, important to observe that, when the local variety multiplies and passes over into areas occupied by the original stock, its continued separate evolution must depend on some other form of isolation.

One form of isolation that may prevent the variety from being swamped by free crossing is seasonal isolation due to its having gained a separate season for propagating. This form of isolation is mentioned in one of the quotations given in President Jordan's article.<sup>1</sup>

<sup>1</sup> See page 552.

Another form of isolation is what Romanes has called physiological isolation, which he defines as the prevention of free crossing due to physiological incompatibility between the reproductive cells of different groups of creatures.<sup>2</sup>

But this extended use of the word isolation is not found in the works of Darwin, and even at the present time many writers follow his usage by treating the term as meaning the prevention of free crossing due to geographical separation. This limited meaning of the word, as used by Darwin and the writers of his time, led me for many years to seek other terms when discussing the broad problem of the prevention of free crossing. Separation and segregation are the terms I have chiefly used.<sup>3</sup>

I observe that E. A. Ortmann in his discussion entitled, 'Isolation as One of the Factors of Evolution,' appearing in *SCIENCE* for January 12, 1906, also uses 'separation' as an equivalent for isolation when meaning the prevention of free crossing. In some of the previous discussions on the subject it has been pointed out that sometimes the nearest allies of a species are found in the same district. In such cases the point of chief interest is that some other form of separation will be found to prevent free crossing between the different races and species. Closely allied plants may bloom at separate seasons and so occupy the same district without crossing. In other cases the pollen of each variety may be prepotent on the stigmas of the same variety. Varieties of birds and mammals differing chiefly in color may be held apart by sexual or social instincts. These and many other forms of isolation have been pointed out in my work on 'Evolution, Racial and Habitual,' published by the Carnegie Institution.

I have also brought together many reasons for believing that without isolation one species can not be transformed into two or more

<sup>2</sup> See 'Darwin and After Darwin,' Part III., entitled 'Isolation,' pp. 43-47.

<sup>3</sup> See my three papers published in the *Linnean Society's Journal*, between 1872 and 1889, also three articles published in the *Amer. Jour. of Science* for 1890.

species; while with complete isolation more or less divergence may result before diversity of selection comes in to intensify the segregation.

Of selection I also discover many reflexive forms due to the influence of members of the same species upon each other, as well as natural selection and artificial selection due to influences lying outside of the species.

In considering the factors producing different inheritable types of related organisms we have to distinguish between the factors dividing the original stock into separate inter-generating groups and those producing diversity of inherited character in the separate groups. The former process we may call racial demarcation through isolation, and the latter racial intensification through survival resulting in selection. Isolation and selection we find to be cooperating factors in controlling racial segregation.

Our investigation of the factors producing evolution will, however, remain very incomplete unless we study the influences producing different social groups, in which different habits of dealing with the environment are originated and maintained, not by variation and heredity, but by innovation and tradition. Here again we must distinguish between the influences dividing the original group into separately associating groups, and those that establish a diversity of habits and acquired characters in the separate groups. The former process we may call habitual demarcation through partition and the latter habitual intensification through success resulting in election. Partition and election we find to be cooperating factors in controlling habitual segregation.

In the bionomic history of many species the great significance of habitual segregation is found in the fact that it is the forerunner of racial segregation.

For illustrations of the influence of habitual segregation on racial segregation I would refer to my work on evolution published by the Carnegie Institution.

JOHN T. GULICK.

OAKLAND, CAL.

#### SALMON HYBRIDS.

TO THE EDITOR OF SCIENCE: I have received from Mr. C. W. Dorr, of the Alaska Packers' Association, certain notes by Mr. J. A. Richardson on experiments in hybridization of salmon, undertaken in the hatchery at Karluk, Alaska. These will be of interest to zoologists.

DAVID STARR JORDAN.

Mr. Richardson writes as follows:

Crosses have been made of all of the salmon family except the steelhead. These experiments have been made for the novelty of it. The peculiarities of each are invariably the same from year to year, and practically none of the fry survive.

The cross between the red salmon and king salmon produces a very queer lot. Out of many thousand eggs hatched, ninety per cent. of the fry will have no eyes; the nose is long and pointed; the sac is of very light color and quite watery in appearance. Only two per cent. or three per cent. are reasonably well formed fish, and the most of these die.

The number of eggs which fertilize is about normal, but it is noticed that a larger number than usual of the white eggs removed from the baskets contain embryos that have ceased to develop. This cross has been made both ways.

It has been demonstrated that the cross between the red salmon male and the humpback female is very superior to other crosses—so much so that it leads to the belief that there is closer relationship between these two species of the salmon family. An extended experiment by crossing these two species is now being carried on. The loss of eggs and fry is being counted and notice taken of general conditions. We have fine specimens from the season 1904 (eggs taken in 1903) of this cross. They are about eight months old, two inches long, and bright, clean, silvery fish, rather long and slim.

#### SPECIAL ARTICLES.

AN INTERESTING DISCOVERY OF HUMAN IMPLEMENTS IN AN ABANDONED RIVER CHANNEL  
IN SOUTHERN OREGON.

DURING July and August, 1905, the writer was in the field in southern Oregon under the

direction of Dr. David T. Day, chief of the Division of Mineral Statistics of the U. S. Geological Survey. The work assigned was the collection of black sands and crude gravels from the placer mines of this section for the experimental concentrating plant of the survey at the Portland exposition. While visiting Waldo, Ore., the following occurrence of human implements in the gravels of the Deep Gravel Mining Company was met, and with the permission of the Director of the Survey is herewith communicated.

Waldo is situated on the stage line from Grants Pass on the Southern Pacific Railroad, one hundred miles south of west to Crescent City on the coast, and is forty miles from Grants Pass. It is in Josephine County, a few miles north of the California line.

Waldo was the scene of the earliest discovery in Oregon of stream placers in the country back from the ocean. Sailors penetrated to it in 1853 and found rich pay-streaks in the bed of a small stream which heads up in the ancient gravels of what must once have been a large river. The discovery received the name of the Sailor Diggings and the name Waldo came later. The ancient gravels are now on top of a ridge and have remained in relief while the former banks have been removed by erosion. The course of the river was to the north, since its bed-rock declines in this direction. The bed-rock as exposed in the placer mines is chiefly serpentine, but in one place the rim-rock is fossiliferous sandstone, which has been studied and determined by J. S. Diller. The boulders are chiefly eruptive rocks of various sorts and are much softened as a rule by decomposition. The exact relations of the old drainage would require more investigation for their elucidation than the writer could give in the brief time at command, and it can only be stated that they cover a rather wide area—east and west—having been mined at intervals for half a mile or more across the main course, but whether this is from forking of the old main channel or not was not determined. Some shallower gravels are probably due to the washing down of the old high channel deposit

over the slopes and on to the flats on either side of its crest.

Pestles appear to occur in the gravels as a not specially exceptional phenomenon. The operators of the mines speak of their occasional discovery as a matter which does not excite surprise. The following instance, however, of two mortars and of one or two pestles attracted the attention of Mr. W. J. Wimer, the manager and part owner of the Deep Gravel property, and although the objects were brought to light in the hydraulicking during the night shift, he carefully recorded the details early the next morning. The following extract from a letter of Mr. Wimer, written at my request, gives the facts. I particularly inquired about the possibility of the bank's caving in so as to make implements from the surface appear as if buried in the deeper gravels, but this possibility seems to be guarded against both by the auriferous cement in the large mortar and by its actual detection in the bank by the pipe man. The mortars and pestles are now in the possession of Col. T. Waln-Morgan Draper, a well-known mining engineer, at whose summer home, a few miles from Waldo, the implements now are.

The mortar is about twelve inches high by nine inches across, and is made of the hardest granite. Two of our night men piped it out in 1902, when it was firmly embedded in a blue cement gravel (the pay channel), fifty-eight feet from the surface. They had to resort to picks to get it out and the bed or hole out of which they pulled it remained, showing its perfect mould. I went to the mine in the morning and those two men formally presented it to me. It was still packed tightly to its very rim with blue cement gravel. With a sharp pick I carefully picked the gravel loose so that I could clean it. I was some time doing so. I then washed the detritus and got eight pretty large colors of gold.

H. M. Pfefferly and D. W. Yarbrough were the finders. The place was in the S.W.  $\frac{1}{4}$  of N.W.  $\frac{1}{4}$ ; Sec. 21; T. 40 S.; R. 8 W.; W.M., Josephine County, Oregon, on the property of the Deep Gravel Mining Co. The other mortar is what Colonel Draper terms a quartz mortar having a saucer-like cavity on its top. The gold from the ground where it was piped out was pronounced by the Selby Smelting Company in San Francisco

to be 'quartz gold,' their receipt to us being so marked. This mortar was probably about 10 feet under the surface. It was 300 yards from the other one and on Sec. 20, being therefore the S.E.  $\frac{1}{4}$  of N.E.  $\frac{1}{4}$ . It was found in 1901. The pestles were discovered with it; they were in pay dirt.

Those occurrences add one more instance to the list of stone implements which have been found in the auriferous gravels of the Pacific coast. The writer fully realizes the criticism which has been brought to bear upon them and the skepticism with which their authenticity is regarded by many. The Waldo case may be stated upon the testimony of Mr. Wimer and Mr. Pfefferly and may add its contribution to the general mass of evidence regarding the antiquity of man in the far west.

J. F. KEMP.

#### ASTRONOMICAL NOTES.

##### THE NEW SOLAR OBSERVATORY OF THE CARNEGIE INSTITUTION.

THE Carnegie Institution of Washington has established a solar observatory on Mount Wilson, near Pasadena, southern California, under the direction of Professor George E. Hale, former director of the Yerkes Observatory. The late Secretary Langley, of the Smithsonian Institution, whose bolometric studies of the solar radiation during many years have added so much to our knowledge of the sun, was active in urging the claims of such an observatory. He desired to see the observatory established in a tropical or subtropical region, with a large equipment and endowment, especially for the study of the solar radiations and their possible fluctuations.

The Mount Wilson Observatory is the outcome of much thought and investigation by different astronomers, and may be depended upon to furnish splendid results. Mr. Langley, however, in a communication to the committee on astronomy of the Carnegie Institution, in 1902, made the following statement:

It has thus far proved, and, so far as can be seen, always will prove, impossible to determine from near sea-level with any precision by any observations, however careful or long continued,

the 'constant' of solar radiation. There is no good way to eliminate the complex effect of atmospheric absorption except to observe at the highest practicable altitude, preferably near the tropics, but most certainly in a dry and clear atmosphere, and preferably where there are two stations in view of each other, the first of which is at a notably greater altitude than the second, though the latter is itself at least some thousands of feet above sea-level. Temporary expeditions with meager outfits have gone from time to time to high mountain stations for solar observations, and small meteorological stations have even been longer continued. What is needed is rather a permanent astrophysical observatory equipped with the most powerful and refined modern apparatus for solar research and located at the highest and clearest station it is practicable to occupy.

These are very strong words from a very eminent authority. It may not be out of place to inquire whether Mount Wilson fulfils the required conditions. Those who have read Professor Hale's description of the conditions which exist on the mountain during a large part of the year, and have seen the results already accomplished, will gladly acknowledge that Mount Wilson offers exceptional advantages for such an observatory. That it is the best which the world furnishes, or that the 'last word' can be said from it in regard to the solar constant may be doubted. The institution on Mount Wilson will undoubtedly justify itself, and is probably the best site which could be occupied under the circumstances. There may be several elevations, however, which more closely meet the conditions imposed by Mr. Langley. The writer is familiar with one, which could hardly meet the requirements more exactly if it had been made to order after that communication was written. The volcanic peak, El Misti, near Arequipa, Peru, rises to an altitude of 19,000 feet. It looks down upon the Arequipa station of the Harvard Observatory, whose altitude is 8,000 feet. The whole region is extraordinarily dry and clear. From the summit of El Misti the sky is most strikingly dark and free from haze. This summit is readily accessible by a mule-trail during nearly the whole year, and its use as a permanent station presents few difficulties

other than those associated with mountain sickness. In this region the railway reaches an altitude of more than 14,000 feet, and some of the mountains rise to more than 20,000 feet. Probably no other part of the world can furnish lofty mountains which are as accessible as those of southern Peru and northern Chile.

Much of the extremely valuable work which has been planned by Professor Hale for the solar observatory on Mount Wilson, whose altitude is 5,886 feet, could not be carried on, perhaps, at an elevation of 19,000 or 20,000 feet; but for certain problems, especially that of the solar constant, it may be that the future will demand the fulfillment of the conditions imposed by Dr. Langley.

#### DOUBLE VARIABLE STARS.

Two interesting cases have recently been discovered by Mrs. Fleming, at the Harvard Observatory, of double stars, both of whose components are variable. That two variable stars should be close together, where variables occur in large numbers, as in the dense globular clusters, or to a less degree in the Magellanic clouds, would not be especially surprising. Even here, however, as a matter of fact, very few really close doubles are found. In the sky as a whole, away from such special regions, the number of known variables in the 40,000 square degrees of the sky is not much more than 600, or one in 67 square degrees. The chance, therefore, that two of them should come within a few seconds of arc of each other, unless there is some physical connection between them, is extremely small.

The first double-variable consists of the well-known variable star *S Lupi* and a close companion, distant only 13", so close, indeed, that it may often have been mistaken for *S Lupi* itself, especially when it was bright and *S Lupi* faint. *S Lupi* has a period of 346 days, and varies in light about three and a half magnitudes, between 9.6 and 13.1. The close companion varies between 10.4 and 12.8, and its period appears to be irregular.

Another variable pair has just been announced. The components are 40" apart. The first component varies between the magnitudes 10.0 and 10.6, and the second, between

10.0 and 12.4. It will be of the greatest interest to determine whether there is any relation between the light-changes of the components, but this has not yet been possible.

It is well known to astronomers that Mrs. Fleming has discovered nearly 200 variable stars by examination of photographic spectra, made with an objective prism, in connection with the work of the Henry Draper Memorial. By discovering that the spectra of long-period variables usually contain the bright lines due to hydrogen, she has been able to 'pick up' large numbers of variables of this class, while engaged in other spectroscopic studies. It would have been quite impossible for a single observer, or, perhaps, for half a dozen, by visual methods, to find such a number in a lifetime. The results illustrate the power of photographic methods when the correct interpretation has been found. In this, as in some other lines of astronomical discovery, it would be almost a waste of time for an observer, unless for purposes of recreation or amusement, to carry on the investigation visually. He would succeed about as well as a person who should attempt to race on foot with a fifty-horsepower automobile. This seems really a pity, as there is undoubtedly a greater charm, at least to the outsider, in the older method. An observer sitting at a desk with photographs about him, in a pleasant room in broad daylight, appeals to the imagination much less than the old-time astronomer, who was supposed to sit through the long, cold night with his eye glued to his telescope. However, there are many fields in which the visual observer still has the advantage.

#### POSITION OF THE AXIS OF MARS.

IN a communication to the *Monthly Notices* of the Royal Astronomical Society, Professor Percival Lowell, director of the Lowell Observatory, gives an account of his observations of the polar cap of Mars, for the determination of the position of the martian axis. He also compares the results of his own determinations at three oppositions with those of Schiaparelli, Lohse and Cerulli. From a study of all the determinations Professor Lowell arrives at the conclusion that the most probable values are

as follows: Pole of Mars, R. A.  $317^{\circ}.5$ ; Dec.,  $54^{\circ}.5$ . Epoch 1905. Tilt of martian equator to martian ecliptic,  $23^{\circ} 59'$ . This value of the inclination of the martian equator is somewhat less than that which has been generally accepted heretofore.

#### RECENT COMETS.

DURING the year 1905 three comets were discovered for which orbits were determined. Two of them were found by Giacobini, and the other by Shaer. So far during the present year two comets have been discovered, by Brooks and Kopff. None of these has been of much popular interest. For an unusually long period no spectacular object, such as the great comets of 1843, 1858, 1881 and 1882, has appeared. One may appear at any time, but of this there is no certainty. However, Halley's periodic comet will be due about 1910, and it will probably be bright.

S. I. BAILEY.

#### SAMUEL PIERPONT LANGLEY.

At a memorial meeting of the board of regents of the Smithsonian Institution, on March 6, the following resolutions were passed:

*Resolved*, That the Board of Regents of the Smithsonian Institution express their profound sorrow at the death, on February 27, 1906, of Samuel Pierpont Langley, Secretary of the Institution since 1887, and tender to the relatives of Mr. Langley their sincere sympathy in their bereavement.

That in the death of Mr. Langley this Institution has lost a distinguished, efficient and faithful executive officer under whose administration the international influence of the parent Institution has been greatly increased, and by whose personal efforts two important branches of work have been added to its care—the National Zoological Park and the Astrophysical Observatory.

That the scientific world is indebted to Mr. Langley for the invention of important apparatus and instruments of precision, for numerous additions to knowledge, more especially for his epoch-making investigations in solar physics, and for his efforts in placing the important subject of aerial navigation upon a scientific basis.

That all who sought the truth and cultivated science, letters and the fine arts, have lost through his death a co-worker and a sympathizer.

That the Executive Committee be requested to arrange for a memorial meeting to be held in Washington.

That Doctor Andrew D. White be invited to prepare a suitable memorial which shall form a part of the Records of this Board.

#### SCIENTIFIC NOTES AND NEWS.

SIR GEORGE DARWIN, K.C.B., Plumian professor of astronomy, will represent the University of Cambridge at the celebration of the two hundredth anniversary of the birth of Benjamin Franklin by the American Philosophical Society.

At a meeting held at the Mansion House, on February 27, the Lord Mayor of London presiding, Lord Halsbury moved "That, in view of this being the fiftieth year of the foundation of the coal-tar color industry, it is desirable that steps should be taken to memorialize the event and to do honor to Dr. W. H. Perkin, the founder." After this motion had been supported and carried, Lord Rayleigh moved "That an appeal be made in this country and abroad for subscriptions for the purpose of carrying out the following objects: (1) The presentation to Dr. Perkin for his life time of an oil portrait of himself, executed by an eminent artist, the portrait to become the property of the nation at his death. (2) The execution of a marble bust of Dr. Perkin to be placed in the rooms of the Chemical Society. (3) The establishment of a 'Perkin Research Fund' for the promotion of chemical research to be administered through the Chemical Society." After this motion had been supported by Sir William Ramsay and Sir Henry Roscoe and carried, arrangements were made for the appointment of a general committee and an executive committee for carrying out the objects of the resolution.

DR. HANS DREISCH, of Heidelberg, has been appointed Gifford Lecturer in Aberdeen University for 1907-9.

THE University of Heidelberg has conferred the Victor Meyer prize on Dr. Ernst Stern for his investigations in organic chemistry.

DR. ROBERT KOCH will return to East Africa, in April, to continue his investigations

on sleeping sickness under the auspices of the German government.

DR. WALTER R. BRINCKERHOFF, of the pathological department of the Harvard Medical School, has been appointed director of the Leprosy Station at Molokai, Hawaii.

THE thirteenth lecture in the Harvey Society course will be delivered by Professor W. H. Howell, of Johns Hopkins University, at the New York Academy of Medicine, on March 17, at 8:30 P.M., on 'The Cause of the Heart Beat.' This is the last lecture of the series given during the present year. The twelfth lecture was delivered by Professor Theobald Smith, of the Harvard Medical School, his subject being 'The Parasiticism of the Tubercle Bacillus and its Bearing on Infection and Immunity.'

PROFESSOR HUGO MÜNSTERBERG will give the last of the Harvard lectures at Yale University this year, on March 16. The subject will be 'Science and Idealism.'

PROFESSOR GEORGE H. HOWISON, of the University of California, will give a course of lectures at Yale University on 'The Human Import of Philosophy.'

DR. G. MARCONI will lecture before the New York Electrical Society, at Columbia University, on March 28. It is said that he will come to the country especially for that purpose.

MR. ANDREW CARNEGIE has contributed £9,300 to complete the fund for a memorial to James Watt, which will take the form of a commemorative public building and statue at Greenock, his birthplace. Subscriptions to the fund from Great Britain amount to £700 and from the United States to £190.

A MEMORIAL tablet has been erected by the London County Council, on the house, No. 110 Gower Street, where Charles Darwin lived from 1839 to 1841.

WE learn from *The British Medical Journal* that the late Dr. Domenico Barbieri, of Vienna, bequeathed a sum of 300,000 crowns for the creation of a fund to be called by the name of Theodor Billroth. Dr. Barbieri was an assistant and a close personal friend of the

famous Vienna surgeon, who entrusted him with the administration of the anesthetic in some of his most daring operations. The interest of the fund is to be given in bursaries to poor students in the Second Surgical Clinic of Vienna, of which Billroth was the head, and, if possible, also to students in the First Clinic. The bursaries, which are to be awarded by the professorial college without distinction of nationality or creed, are of the yearly value of 2,000 crowns, and are tenable for three years.

THE death is announced of Professor Jean Louis Cabanis, the well-known ornithologist, for many years curator in ornithology at the Berlin Museum.

ANNOUNCEMENT was made at the opening, on March 5, of the Widener Memorial Home for Crippled Children, that Mr. P. A. B. Widener, who gave \$2,000,000 for the building, has given \$3,000,000 for a maintenance fund.

THE Verein Deutsche Ingenieure, which has more than 20,000 members, will celebrate its fiftieth anniversary this year, the meeting being held at Berlin from June 10 to 14.

THE Royal Sanitary Institute will, this year, hold its congress in Bristol from July 9 to 14, under the presidency of Sir Edward Fry. The Snell prize of the institute consists of £50 and a medal which is offered this year for an essay on 'Suggestions for improvements in sanitary appliances for use in workmen's dwellings and laborers' cottages under the varying conditions of water supply and drainage usually obtaining in towns and villages.'

ON La Zacualpa plantation in Chiapas, Southern Mexico, there has been established a botanical station, the principal object of which is to study the Central American rubber tree (*Castilla elastica*), its culture, and the preparation of commercial rubber from this tree. On La Zacualpa and affiliated plantations there are now planted over three million trees and at least two additional million trees will be planted. In connection with the botanical station, there is a laboratory for chemical and physiological investigation of the latex. A complete meteorological observatory

will soon be ready on La Zacualpa, and two meteorological substations will be established in the mountains close by, where simultaneous observations will be made at the elevations of 2,000 and 3,500 feet. The main station is situated at 250 feet above the sea, twelve miles from the Pacific Ocean, on the lowlands at the foot of Sierra Madre, about sixty miles from the border of Guatemala. The director of the station is Dr. Pehr Olsson-Seffer from Stanford University.

#### UNIVERSITY AND EDUCATIONAL NEWS.

PRINCETON UNIVERSITY has been made the residuary legatee of the estate of Mrs. J. Thompson Swan, which is said to be worth about \$300,000. The legacy will be used by the graduate school.

THE late Edwin Gilbert, of Georgetown, Conn., has left public bequests amounting to \$250,000, including \$60,000 for the model farm of the Connecticut Agricultural College.

HARVARD UNIVERSITY has received a gift of \$50,000 from Robert Wilcox Sayles, A.B. ('01), of Norwich, Conn., to establish a fund, preferably for the 'acquisition, preparation and maintenance of collections suitable for a geological museum.'

LORD RAYLEIGH has sent to the vice-chancellor of Cambridge University £7,733 12 s. 8 d., being the amount of the Nobel prize awarded to him in 1904. Lord Rayleigh desires that £5,000 of this should be employed in erecting a new building in connection with the Cavendish Laboratory, and that the remainder should be devoted to the purchase of scientific books and periodicals for the University Library.

AT a recent meeting of the faculty of arts and sciences, of Harvard University, last week, it was voted to establish a department of education. Heretofore all courses in education have been included in the department of philosophy. Professor Paul H. Hanus is at the head of the new department.

DR. LESTER F. WARD, who has long been connected with the U. S. Geological Survey and the U. S. National Museum, and is

eminent for his contributions both to sociology and to paleobotany, has been elected professor of sociology at Brown University. He will take up the work of the chair in September.

DR. C. S. MINOT, professor of histology and embryology in the Harvard Medical School, has been appointed James Stillman professor of comparative anatomy.

DR. WILLIAM HALLOCK, professor of physics, Columbia University, has been appointed dean of the faculty of pure science.

MR. RENNIE W. DOANE, A.B. (Stanford, '96), has been appointed instructor in economic entomology and curator of the entomological collections at Stanford University.

MR. E. T. WHITTAKER, F.R.S., has been appointed Andrews professor of astronomy in the University of Dublin and royal astronomer of Ireland, in succession to the late Professor C. J. Joly, F.R.S.

AT Manchester University Dr. William Mair, Riddell demonstrator in pathology and bacteriology in Queen's College, Belfast, has been appointed demonstrator in pathology; Dr. John Cameron, junior demonstrator in anatomy, has been appointed a senior demonstrator; Mr. C. M. Craig, has been appointed a junior demonstrator in anatomy; and Dr. F. W. Gamble, lecturer and demonstrator in zoology, has been appointed a senior assistant lecturer.

MR. CHARLES H. LEES, lecturer in physics and assistant director of the physical laboratory of the University of Manchester, has been appointed professor of physics of the East London College.

DR. F. KRUGER, docent in philosophy at Leipzig and assistant in Professor Wundt's laboratory, has accepted a call to a chair of philosophy in Buenos Ayres.

DR. A. KOLLE, of the Institute for Infectious Diseases at Berlin, has been appointed professor of hygiene and director of the Sero-therapeutic Laboratory at Bern.

DR. Clemens Schlüter is about to retire from the chair of geology and paleontology at Bonn.